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RADIO

Established 1917 as Pacific Radio News

Volume IV *for* MAY, 1922 *Number 5*

CONTENTS *for* MAY, 1922

RADIO is Published Monthly by the Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, Calif.

ARTHUR H. HALLORAN, *Editor.*
LAWRENCE MOTT, *Associate Editor.*
GERALD M. BEST, *Technical Adviser.*
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H. W. DICKOW, *Advertising Manager.*
Branch Offices: 147 Sixth Ave., New York City; 6442 Ingleside Ave., Chicago; 140 So. Oxford St., Los Angeles, Cal.

Advertising Forms Close on the First of the Month Preceding Date of Issue

Issued Monthly, 20c a copy. Subscription price $2.00 per year in the U. S., $2.50 per year elsewhere. Instructions for change of address should be sent to the publisher two weeks before the date they are to go into effect. Both old and new addresses must always be given.

Entered as second-class matter at the Post Office at San Francisco, Calif., under the Act of March 3, 1879.

Forecast of Contributions for June Issue

Announcement is made elsewhere in these columns of an increase in size to one hundred pages monthly, commencing with the next issue. The addition of sixteen pages to the present size will enable the presentation of much more material of interest and value to the radio amateur and experimenter without in any way detracting from the high editorial standard of contents which the editor tries to maintain.

The leading article will be an illustrated description of the new army station at the Presidio of San Francisco, the first of a series of new stations which will enable the establishment of regular communication across the continent. This will be written by Captain C. I. Hoppough, Signal Corps, U. S. Army.

The next installment of the "C. W. Manual," by Ensign J. B. Dow, will give full details for constructing an inexpensive 50 watt transmitter for use when 60 cycle a.c. is available.

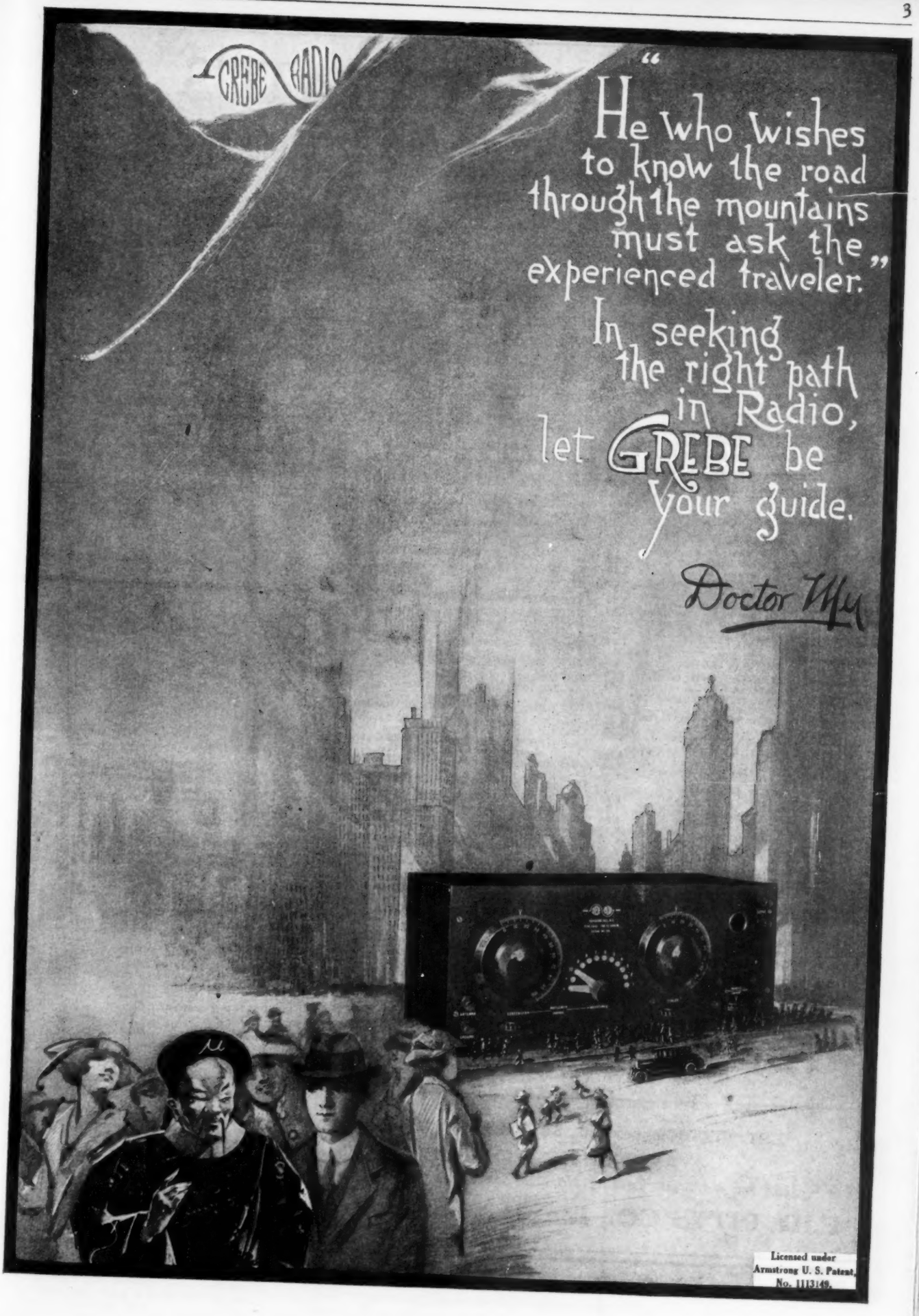
In the line of fiction V. C. Mathison has a story entitled "The Conquest of Ouglamuck," which tells of the exciting experiences of a wireless engineer in Alaska. Earl Ennis will have some more enjoyable "Grid Leaks," with cartoons by C. J. Dow. David Gibbons will have Scratchi say some serious truths in a humorous way.

Gerald M. Best has found a remarkable crystal detector with tube amplifier which gives almost unbelievably good results. He will tell all about it in June RADIO. D. B. McGown will discuss "Navy Standard Transmitters." Many other articles of a practical nature are in store for you in the June issue, "the best yet."

O. Schuwendt, whose excellent mechanical drawings of circuits and apparatus add to the value and appearance of most of our technical articles, will contribute an article on the construction of a 10-watt, self-rectifying transmitter which he has recently tested out with excellent results. The detail drawings accompanying the article should prove particularly helpful to those who will use them as a guide in making a similar set for themselves.

R. C. Anderson has an unusually good regenerative receiver tuning from 200 to 5000 meters with great selectivity and high amplification which he will offer to those who prefer to "roll their own."

"The Simple Receiving Set" will be the subject of the next in the series of the Radio Primer being written by H. A. Eveleth. It will include an understandable discussion of inductance and capacity and also brief reference to the principles of the radio compass.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In seeking the right path in Radio, let GREBE be your guide.
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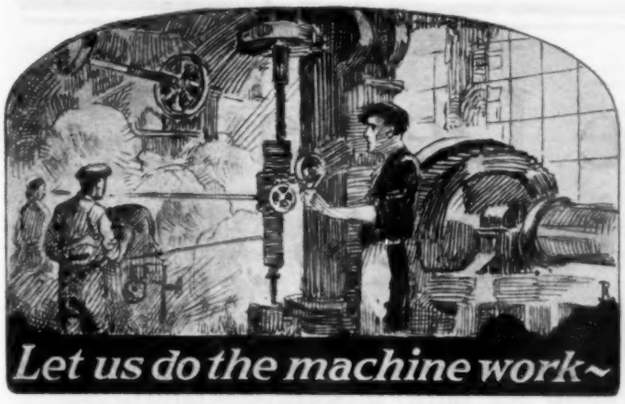

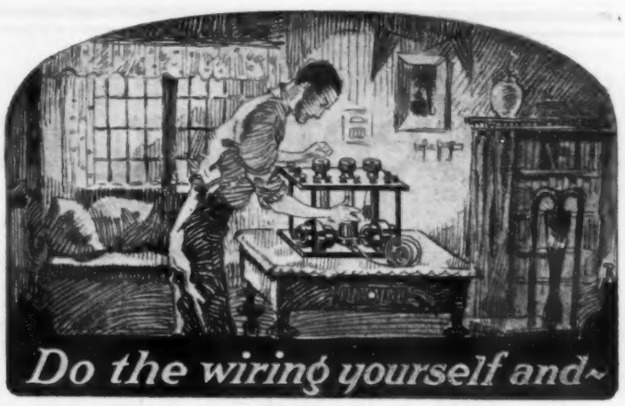

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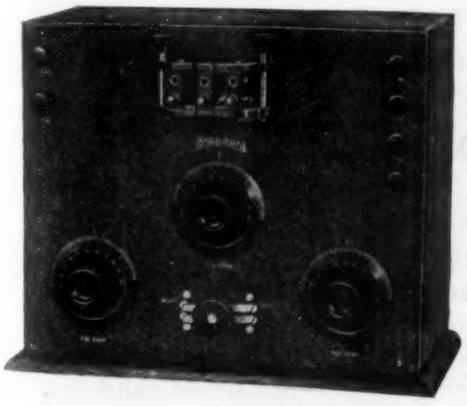

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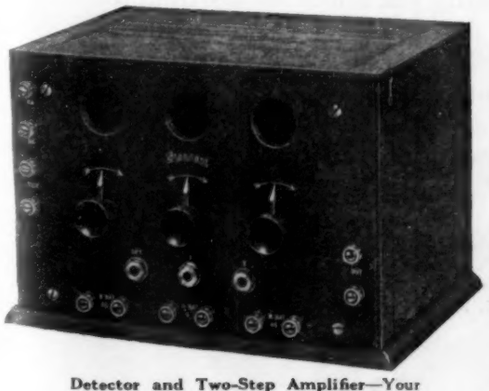
Price, completely assembled, F. O. B. New York, $45.00

Set of 18 DL Coils, to receive all the most used wave-lengths, **$40.00.**



Detector and Two-Step Amplifier—Your choice of two types, Commercial or Amateur. The commercial type is assembled from the most costly, efficient units available. Radio Corporation UV-712 transformers and General Radio tube receptacles typify the quality throughout. The Amateur type is an exact duplicate, except that transformers and sockets of high efficiency, but lower cost, are used.

Prices, F. O. B. New York:

Commercial type, unwired.....$55.00
Amateur type, unwired..... 47.00

Here is clear saving of $10.00 in either case, thru the "Standard" Plan.

THERE are two parts in the building of radio apparatus; first the actual panel drilling and assembling, and second, the wiring.

The first is essentially machine work. At the same time, because it *is* machine work, it is really the less expensive part of the entire assembly.

The wiring, which is hand work, is the expensive part and also the part which you can do just as well yourself. The Standard Plan gives you an opportunity to secure commercial grade correctly assembled apparatus at prices only slightly more than you would pay for the individual instruments.

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The wiring, which is expensive hand work, is left for you to finish. You can incorporate your own circuit if you wish, or, you can follow the wiring diagrams which are provided with every instrument.

Take advantage of the Standard Plan and save the expensive wiring costs. Only in this way can you get fully assembled high quality apparatus at such low prices.

Take this opportunity to ***try*** the Standard Plan at ***our*** Risk!

So confident are we that you will be delighted with the Standard Plan, that we will ship any Standard instrument for your inspection without obligation. Simply send a deposit of ⅓ the purchase price with your order. Examine the instrument carefully. If satisfactory remit the balance, but if you are not fully convinced that Standard apparatus is the best value in radio today, simply return the instrument and your deposit will be refunded less carrying charges.

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Meeting the Demand for Radio Sets

IT is natural that broadcasting, *carrying news, music, lectures, concerts and even grand opera* into the homes of the American people, should have created a concerted and impatient demand for radio sets and apparatus—especially the popular radio receiving sets.

If the demand for radio sets and apparatus had grown normally, the well-equipped and highly-organized factories supplying the Radio Corporation of America would now be producing an excess over the market requirements.

Under the present expansion program of the Radio Corporation of America it is quite possible that there will be a surplus production within six months.

A Greatly Expanded Program

The factories manufacturing for the Radio Corporation of America are operating on a greatly expanded production program. *They are straining every nerve and muscle to meet the demand.*

It is not merely a question of men and raw materials. There are limiting factors in some of the delicate equipment parts, and even when all production is running evenly, new jigs, dies and tools must be especially designed, manufactured and installed before the production forces can be increased.

As a result of the efforts that are being made, it is expected that within the next few weeks considerable quantities of material will be shipped on orders already placed. This applies to all classes of radio sets and apparatus, and especially Radiotrons, Vacuum Tubes, etc., which are employed for reception.

The assurance can be given that every scientific, manufacturing, organizing and financial resource of the Radio Corporation of America is being used to meet the demand for radio devices.

We are working to the utmost, not merely to supply the demand, but to put into every set and every piece of equipment complete quality, and as much permanent satisfaction as a rapidly developing art will permit.

We are asking the aid of our distributors and dealers in explaining the capabilities and limitations of radio sets and apparatus, and we welcome their co-operation and indulgence, as well as that of the public itself, until the present expansion program is carried out.

A new R. C. A. Catalog, covering all the radio devices being manufactured for the Radio Corporation of America, will be ready for distribution within thirty or forty days. This catalog will contain timely and helpful information of great value to the wholesale distributor, the retail dealer, and the user of radio apparatus.

Radio Corporation of America

WORLD WIDE WIRELESS

Sales Department, Suite 180 4
233 Broadway, New York City

May, 1922 **RADIO** Vol. 4 No. 5

Radiotorial Comment

MANY people are raising the question as to who will maintain radiophone broadcasting stations in the future. Most of the present stations are maintained by manufacturers or dealers as a means for stimulating the sale of radio receiving sets, or by newspapers as a means for sensational publicity. As the expense of installation and maintenance is relatively high and as there is no present practical method of charging for this service to the public, there is likelihood that the manufacturers and dealers will be compelled to discontinue this service when the market becomes saturated, and there is a possibility that the newspapers likewise may cease broadcasting as the novelty wears off.

The answer is found in the recommendation of the Washington Radio Conference "that radio communication is a public utility," and in the fact that definite bands of wavelengths have been set aside for broadcasting from government stations and public institutions. The broadcasting of information of all kinds will soon become as much of a public necessity as are good roads. The inaugural address of the next president of the United States will undoubtedly be heard by the people of the country by radiophone. The Borough of Queens, New York City, is considering the installation of a municipal station. On every hand there are signs to show that the broadcasting of the future will be conducted as a governmental function or at least as a governmentally regulated monopoly.

AMERICA has gone insane over radio. Its fascination and wonderful possibilities have fired the popular imagination and created an overwhelming demand for any old thing that will receive radiophone speech and music. Overnight, a boy's toy and a laboratory instrument has become a necessity for every real home.

Radio's rapid rise to popularity is as unprecedented as it was unexpected. The manufacturer, jobber and dealer were unprepared for the onslaught of orders with which they have been bombarded. Dealer's shelves are empty, jobbers are six months behind in deliveries and manufacturers have doubled, trebled and quadrupled production facilities in a frantic effort to meet the demand. Newspapers all over the country have started radio pages and broadcasting stations. Department, drug, clothing and delicatessen stores are selling radio apparatus.

Such a time of wild, crazy enthusiasm calls for cool heads and words of caution. The radiophone is a new and unperfected piece of apparatus. It has been developing in the short period since the war. It is still a crude and inefficient device compared to what it will ultimately be. The few men who really know something about it are hard at work making improvements in transmitters and receptors that will soon make the present apparatus as obsolete as the Chinese junk. Meantime, men who know little or nothing about radio are busily making Chinese copies of old stuff to be sold to an unsuspecting public at fabulous prices.

These are disagreeable facts; but they are true. When the disillusioned public learns that it is being bunked with junk there is likelihood of a reaction and refusal to buy until the radio art catches up with the standard of its possibilities.

Much of the responsibility for this condition rests upon the daily newspapers which sensationally paint the future as an accomplished fact. Radio is too wonderful and useful as it is to require the playing up of any false ideas as to what it is accomplishing. It is also a highly technical subject which calls for a thorough understanding of electrical principles in order to get the best results. But its very complexity gives it the attraction that always attaches to the unknown and its very mysteries inspire the desire to solve them.

The mass of gross misinformation on radio that is being printed by the daily press is as dangerous as it is deplorable. Some fool is going to try to "hook up" a radio set to an electric power wire so as to take advantage of the newspaper accounts of General Squier's able development of "wired wireless." Other ambitious youths will spend much time and money in the erection of the inefficient aerials and in the installation of the discredited hook-ups now appearing in many radio pages. Others will waste hours of valuable time reading articles written by men who know nothing about what they are writing. It is difficult enough for the technical editor to discriminate between the good and the bad without passing the burden on to the uninformed reporter who has been drafted to the service because no one else was available. This structure does not apply to all the papers, for some are publishing worthwhile information. But the average reader should realize that a story is not necessarily true because it is interesting, and that in the hurry and scurry of getting out a daily newspaper there are many errors, both technical and typographical, that get by.

In the citation of these facts we do not mean to intimate that every ten year old cannot "tune in" and enjoy the novelty of radio speech and music. Nor is it our intention to deter the progressive man or boy from amusing and instructing himself in this greatest invention of the twentieth century, for only by so doing will he be in a position to get the fullest benefit from the forthcoming advances in the radio art. But we do want to warn the average man that radio reproduction is not yet as undistorted as the natural voice or musical instrument, that only the best of the present equipment will survive, and that his breakfast newspaper page should be as liberally sprinkled with salt as are his eggs.

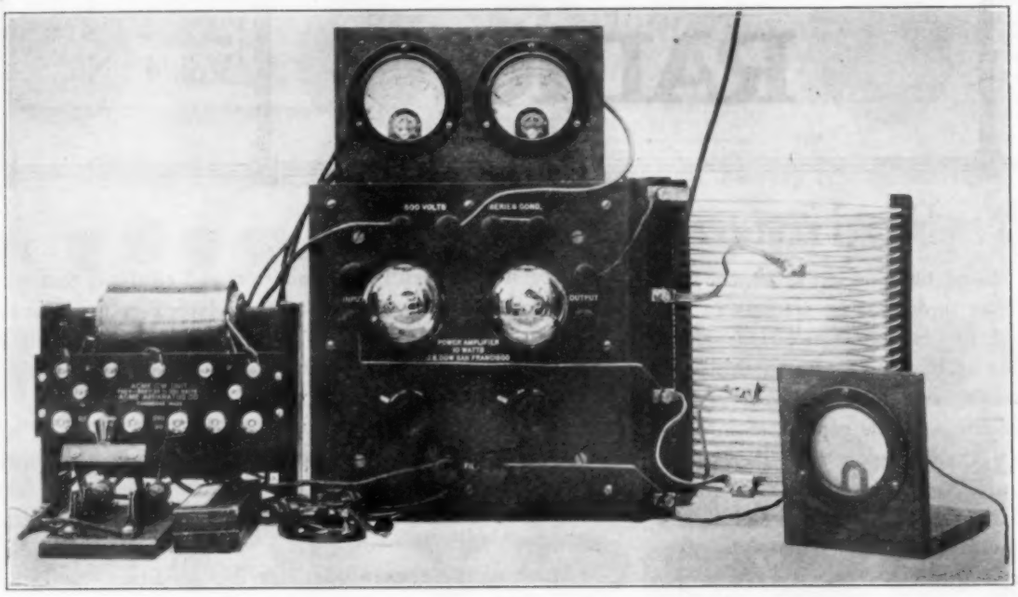


Fig. 42
Complete 10 Watt C. W. Transmitter Operating on Pre-rectified A. C.

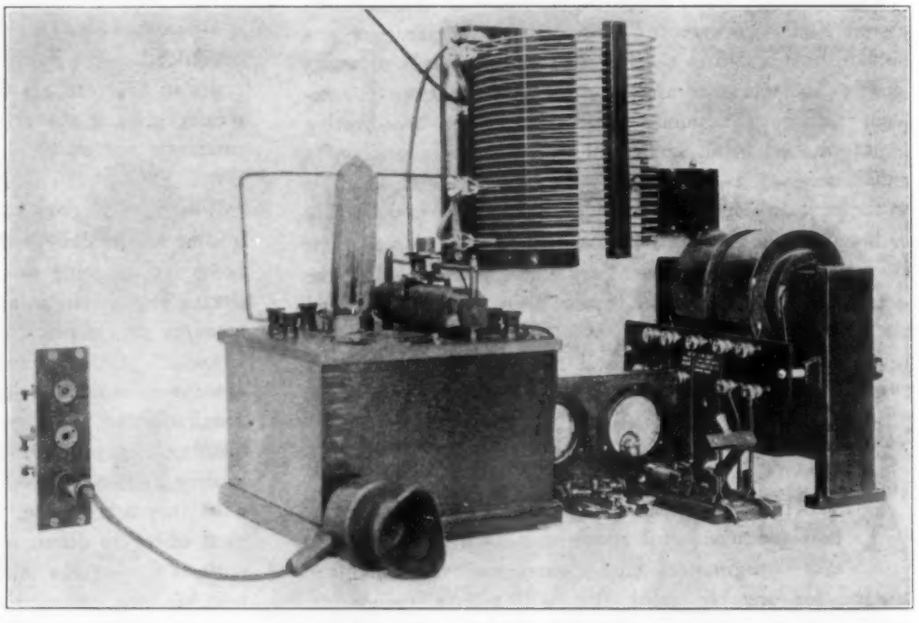


Fig. 44.
50 Watt C. W. Transmitter Using 50 Watt Combination Amplifier as an Oscillator.

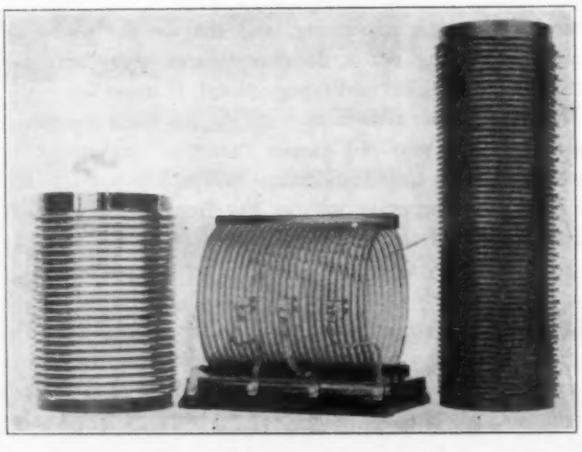


Fig. 45
Well designed Types of Output Inductances

Design and Construction of 10 Watt C. W. Transmitter for Use on A. C.

Fifth Installment of "The C. W. Manual"

By J. B. Dow, Ensign U. S. N.

THE rating of ten watts is conservative for the apparatus that we shall consider in the present chapter. It might more appropriately be defined as a combination operating on alternating current and employing two 5 watt tubes when both sides of the cycle are utilized by pre-rectification and four 5 watt tubes when self rectification is used. Indeed, such combinations, when using the very rugged transmitting tubes of today, often put three times their rated output energy into the radiating system.

The chapter will be devoted to such apparatus as will be used for the transmission of telegraphic signals only; it being understood, however, that with slight modification the arrangement may be converted into one for transmitting voice signals as well.

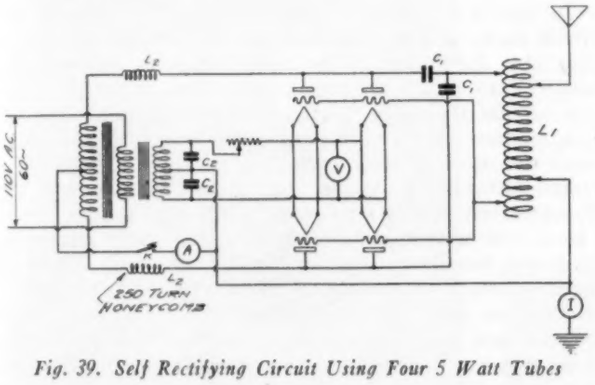


Fig. 39. Self Rectifying Circuit Using Four 5 Watt Tubes

Three circuits present themselves: one in which self-rectification is resorted to (see Fig. 39); one in which the high voltage alternating current is previously rectified by means of two rectifier tubes; and another in which the inexpensive electrolytic rectifier supplants the tubes of the second circuit. The latter circuits are illustrated in Fig. 40.

Fig. 15 represents a circuit in which one tube only is employed on alternating current, and in view of the unilateral conductivity which is an inherent factor in the physics of the thermionic valve, the tube is idle during the portion of the cycle when the plate is negative. In other words, the same effect is produced insofar as the operation of the circuit is concerned as would be produced by substituting a pulsating direct current supply to the plate in lieu of the alternating supply. The emitted signals consist, therefore, of trains of radio frequency oscillations, the train frequency corresponding to that of the alternating supply to the plate. In Fig. 16, two tubes are employed and both halves of the cycle supply a useful current to the plates of the respective tubes. Fig. 41 shows the oscillating output current graphs of the two circuits. As will be seen, Fig. 39 is merely a modification of Fig. 16. (Figs. 15 and 16 appear on page 17, February RADIO.)

The transformer for supplying the high voltage to the plates and the filament heating current will be considered first, and in developing this piece of apparatus we shall go somewhat beyond a device for this circuit alone, in that it will be designed with the idea of using it for furnishing a filament current for rectifier tubes also. This additional winding is quite easily provided and the possibility of a future use for it warrants the small amount of additional labor required to make same.

Upon one of the long legs of a laminated silicon steel core having a 1½ by 1½ in. section and a 1½ by 4 in. window wind a primary for 116 volts of 220 turns of No. 14 D.C.C. magnet wire in four layers, insulating same from the core with six wraps of 5 mil fish paper and each layer from the next with one wrap of the same material. Bring out three additional taps at 193, 200 and 210 turns for supplementary voltage control. Over this coil place six wraps of the 5 mil fish paper and wind a secondary consisting of 3000 turns of No. 28 enamel insulated magnet wire, insulating each layer from the adjacent one with a single wrap of thin paraffin paper. Tap the secondary at the center and at 1100 turns on each side of the center. This will provide a 700 and a 500 volt winding on each side of the midtap, allowing

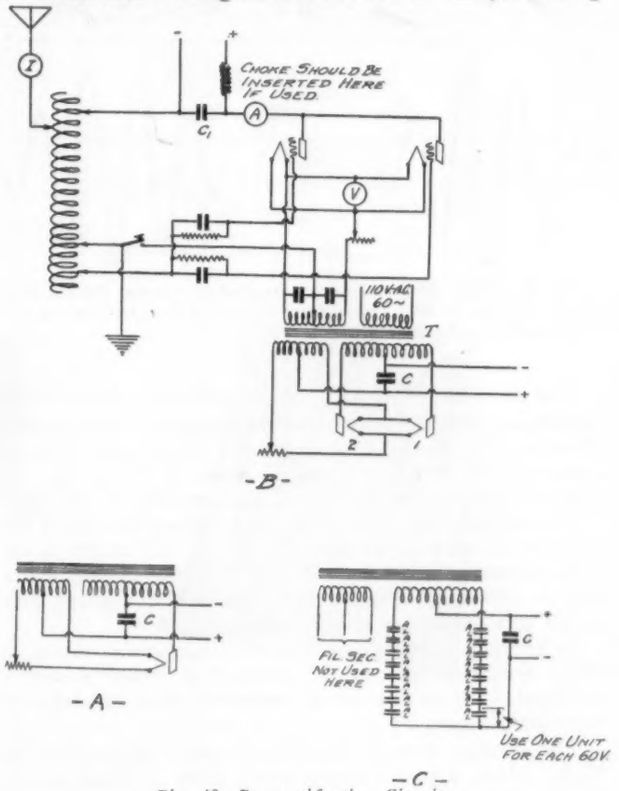


Fig. 40. Pre-rectification Circuits

for a conservative magnetic leakage factor and a nominal voltage drop at the rated output.

On the other long leg of the core wind two coils of 24 turns each of No. 14 D.C.C. magnet wire tapping each coil at the center, thus providing a midtap for the return filament to grid connection to eliminate the hum which would otherwise be present in the received signal because of a grid to filament connection to either end of this winding. To facilitate the matter of making connections to the various taps a suitable panel and arrangement of binding posts should be provided for this transformer.

The variable inductance, L_1, Fig. 39, should consist of approximately 35 turns of 1/16 by ¼ in. edgewise wound copper tape or the equivalent in 3/16 in. outside diameter copper tubing. Solid copper wire (about No. 6) may be used instead of the above with a slightly appreciable increase in resistance for the total coil. Four clips should be provided with this inductance for making connections. Two blocking condensers, C_1, having a capacity not less than 0.002 microfarad each or a multiple condenser having a

total capacity of 0.004 microfarad with a midtap must be used in the plate to inductance leads to prevent the short circuiting of the high voltage transformer secondary by the inductance, L_1.

The radio frequency chokes, L_2, consist of 250 turn honeycomb coils. The bypass condensers, C_2, for the filament secondary may conveniently consist of ½ microfarad telephone condensers.

The transmitting key should be placed at K, in series with the plate milliammeter which should have a scale reading to 300.

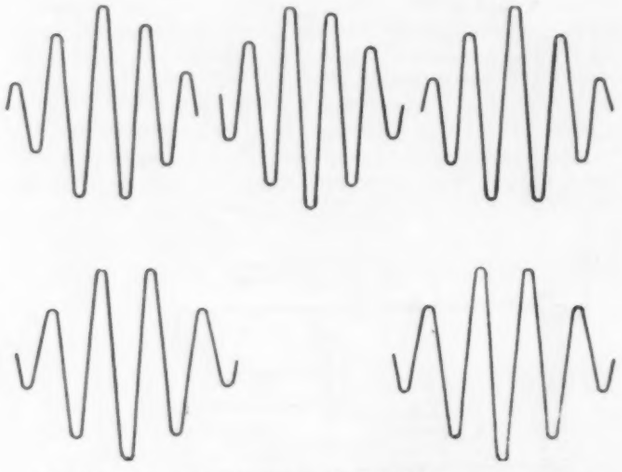


Fig. 41. Upper Drawing Shows Oscillating Current Output from Circuit of Fig. 15, and Lower from Circuit of Fig. 16. Only a few Oscillations per Train Are Shown.

The most recent practice in transmitting tube circuits requires a voltmeter in the filament circuit to secure proper filament adjustment in place of the much used filament ammeter, and accordingly one is shown at V in Fig. 39. This instrument should have a scale reading to 12 volts.

The radiation ammeter in the ground lead may be of the hot wire or thermo element type with a 2.5 ampere scale.

In connection with the adjustment of this circuit, attention is invited to Chapter III wherein the required procedure and caution are considered in detail.

As previously mentioned, Fig. 40 illustrates a circuit in which pre-rectification of the alternating current source is employed. Let us first discuss pre-rectification by means of thermionic valves.

The simplest form of rectifier circuit is shown in Fig. 40-A. Here, a single tube allows a plate to filament current (inside the tube) to flow when the plate is positive and permits of no flow when the plate is negative. It is of course positive during one-half of the cycle and negative during the other, and phenomena mentioned above results in a pulsating direct current supply to the capacity C of Fig. 40-A, charging one side of the condenser dielectric with positive charges and the other with negative changes. If the drain on the condenser C, resulting from a withdrawal of energy by the oscillator tubes is such as to completely discharge same during each cycle, the oscillating output of the radio energy circuit will be pulsating and an audio note corresponding in frequency to the supply to the rectifier tube will be in evidence at the receiving station. This low frequency note will be found objectionable. Notwithstanding this feature, the oscillator tubes cannot be worked at maximum output for they are idle during a large portion of the time.

Fig. 40-B shows a circuit in which two rectifier tubes are used. During the portion of the cycle when the plate of the first tube is positive, this tube supplies useful energy to the condenser C, and the second tube is idle because the plate is negative. During the other portion of the cycle, the plate of the second tube is positive and it supplies the useful energy to the capacity or *storage tank C.*

A moment's thought to what has been said will convince the reader that it is very desirable, then, to have as large a capacity as possible at C.

A two microfarad paper dielectric condenser, designed to withstand the impressed e.m.f. is ideal for this purpose, although one having as little as 0.25 microfarad capacity will suffice.

It should be observed here that the midtap of the high voltage secondary winding of the transformer in Fig. 40-B is the negative side of the direct current supply to the oscillating tube circuit and the center tap of the filament secondary is the positive side.

To further smooth out the pulsations it is recommended, though unnecessary for telegraph work, that a 2 or 3 henry choke be inserted in the positive leg of the rectifier output circuit. The necessary details for the construction of such a choke coil will be found in Chapter III.

The capacity C_1 of Fig. 40, is unnecessary if the above mentioned choke coil is not used in the rectifier output leads, but it must be inserted in the circuit in case the choke coil is used.

In case it is desired to use electrolytic rectification the circuit shown in Fig. 40-C may be used. Observe here, however, that the midtap of the high voltage secondary is the positive lead rather than the negative one as found in the case of the thermionic rectifiers above. Suitable electrolytic rectifier units may be constructed by placing one aluminum and one lead plate, each 1 in. by 1/16 in. by 5 in. in length (allowing for connection) in pint Mason fruit jars three-quarters full of a saturated solution of sodium borate (borax) or ammonium phosphate. The plates should be immersed for about 3 in. of their length and should be separated from one another a distance of approximately 2 in. One of these units is required for each 60 volts to be rectified and if it is desired to rectify both sides of the cycle as shown in Fig. 40-C, twice this number of units are necessary. The plates of each unit must be *formed* before the device is operative as a rectifier. This consists in depositing a white crystaline formation upon them. To do this, connect a 500 volt alternating current source to the plates of one unit, first immersing the jar for about two-thirds of its height in cool running water to maintain a constant temperature. One side of the high voltage secondary may be used for supplying the necessary 500 volts, although the transformer may get hot and may have to be operated intermittently to prevent overheating. The process of forming the plates requires approximately two hours and is complete when the aluminum plate sparks profusely over its surface. A condition may come about in the formation of the plates wherein the aluminum plate fails to spark after a reasonable time, in which case it will generally be found that the plate has become dark and covered with scabs. If this condition exists, begin the process all over again with a new plate, for it is a difficult task to clean such plates.

As was found to be the case with other systems of rectification, a choke coil inserted in the positive lead from the condenser, C, assists materially in smoothing the output for telephonic purposes.

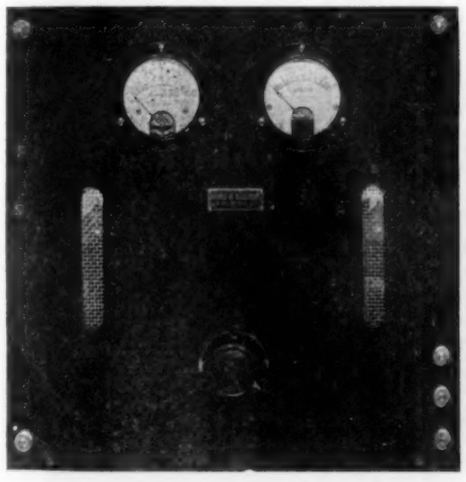
In the circuit of Fig. 40 individual grid leaks and grid condensers should be used to bring about the required negative grid potential. A capacity of 0.002 microfarad shunted with a resistance of 5000 to 10,000 ohms will be found satisfactory.

Compensation for radio artists is to be required by the Actors' Equity Association of New York, which has adopted a ruling that the radiophone is competing with the theater, and that those who talk or sing in the transmitting apparatus must be paid.

Construction of 100-Watt I. C. W. Transmitter for C. J. Dow, Hawaii

By Gerald M. Best and Ralph Heintz

THE consistent reception of 200 and 375 meter signals, both spark and C. W., in the Hawaiian Islands, at the station of Clifford J. Dow (6ZAC), has created a great deal of interest along the Pacific Coast, where, as would be expected, most of the stations Mr. Dow has heard are located. Many thought this record reception to be freaky and were inclined to be skeptical, but with the latest reports from Mr. Dow, showing continued reception night after night of stations such as XFI, which is 5000 miles distant, on the Atlantic Coast, and numerous intermediate fives, eights and nines, ample proof is furnished that Mr. Dow has set a record for short wave reception second to none. All his work has been done with a loose coupler, detector and one-step amplifier, connected to a 50-foot antenna suspended to a neighboring palm tree.



Front View of Set

Mr. Dow has, for some time, had a very healthy ambition to be able to reply to those he hears, not by letter, but with a transmitter of his own. However, since he does not boast of being the sugar king of Hawaii, and hence is not desirous of installing either a thousand dollar antenna system or a miniature radio central, it remained for some of his C. W. friends in the States to get together some sort of a transmitter for him, which would be reasonably priced, simple and economical to run, and capable of covering the 2200 mile stretch of water between Wailuku and the nearest point on the California coast, as well as packing an extra kick to travel still greater distances over land.

We could think of no better type of transmitter to meet these needs than two 50-watt tubes in a Hartley self-rectifying I. C. W. circuit, as shown in Fig. 1. There are no expensive pieces of apparatus such as generators, etc., to buy and no great outlay would be necessary in its construction. Some may object to the single coil circuit used in the oscillator, saying that such a circuit does not have such a sharp decrement, and is subject to swinging. Since Mr. Dow's signals are expected to be heard on the ordinary regenerative receivers, and not on special and very delicate super-heterodyne apparatus, it would appear that a slightly broader wave is to be desired. The decrement of a transmitter of this sort is around .03 to .04, or about twice the decrement of a very sharply tuned two coil C. W. transmitter, and tests on Mr. Dow's completed set, when connected to a small amateur antenna, showed a decrement of .032, which is all that can be desired for sharpness. If Mr. Dow follows the usual precautions of thoroughly guying and securely fastening his new antenna, he will not have much trouble from swinging signals.

Accordingly, the apparatus indicated in the diagram was assembled and the completed transmitter is shown in the illustrations. Not a single item of material was used that could not be purchased readily in the stores. The panel is of ⅜" Formica and all the wiring is No. 12 B. & S. solid copper with varnished cambric sleeving for insulation. The power transformer and key are separate from the main transmitter, for the purpose of convenience in shipping. The assembly work was done by Heinz & Kohlmos in San Fran-

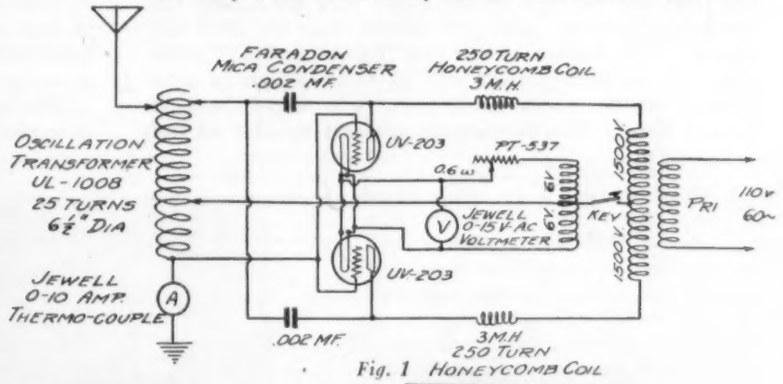
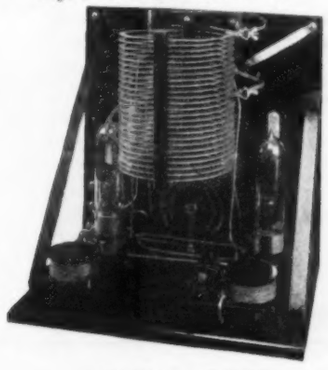


Fig. 1



Rear View of Set

cisco, and the character of their work is shown in the fact that not one case of trouble was found when the transmitter was tested on an antenna, and a radiation of 5 amperes on 200 meters was obtained within 10 minutes after the set was put on test. The power supply at Wailuku is 60 cycle 110 volt a.c., so that no special transformer had to be constructed to meet unusual conditions.

After the transmitter had been thoroughly gone over, and everything found O. K., DX work was commenced in earnest and such stations as 5ZA in Roswell, N. M., a distance of 1000 miles, and many others, were worked with ease. Finally, a cablegram was sent to Mr. Dow, making an appointment with him to listen in on the night of Wednesday, February 22nd, for his own transmitter, and test messages were directed to him over a period of about an hour. The following morning we received the joyful news by cable from Dow, "Signals QSA throughout transmission," showing that the transmitter has certainly lived up to expectations.

Having thus proved its worth, the complete outfit was

packed up and sent on its long journey to Wailuku, and before many weeks we shall have the pleasure of working Hawaii, not to speak of the pleasure on Mr. Dow's part of working the good old U. S. A.

It is as simple a set as can be built without sacrifice of efficiency. Many expensive pieces of apparatus common to most sets of this class are entirely eliminated. No grid leak or grid condenser is employed, and only two condensers of fixed value are necessary.

Since a balanced circuit is employed every effort was made to carry this balance into the arrangement of the various elements. The result was a pleasing symmetry of appearance, simplicity in wiring and general accessibility. All the parts and wiring belonging to each tube are thus divided along a center line and such elements as the inductance, filament rheostat, etc., which are common to both tubes, are bisected by this center-line.

In order to make the connections between the various parts of the circuit as short and as direct as possible the condensers and radio-frequency choke coils are mounted on a bakelite bridge. This bridge also serves to support the binding posts for the high tension input, thus minimizing the operator's chance of coming in contact with the 1000 volt supply. The absence of switches, knobs, dials and other pieces of like paraphernalia will no doubt discourage some amateur of the genus knobtwister, who would have to content himself with running the filament rheostat up and down. However, the amateur who is seeking results, who wants the greatest efficiency with the least cash outlay and fewest number of parts is content with only those controls which are necessary to proper tuning. In the following description the element of uncertainty is entirely removed. The question of efficiency is best answered in that the set worked the Hawaiian Islands from Oakland, California, on its first attempt and the question of cost can be answered by the definite statement that by buying all of the materials in the open market at retail prices the complete set will cost $187.94.

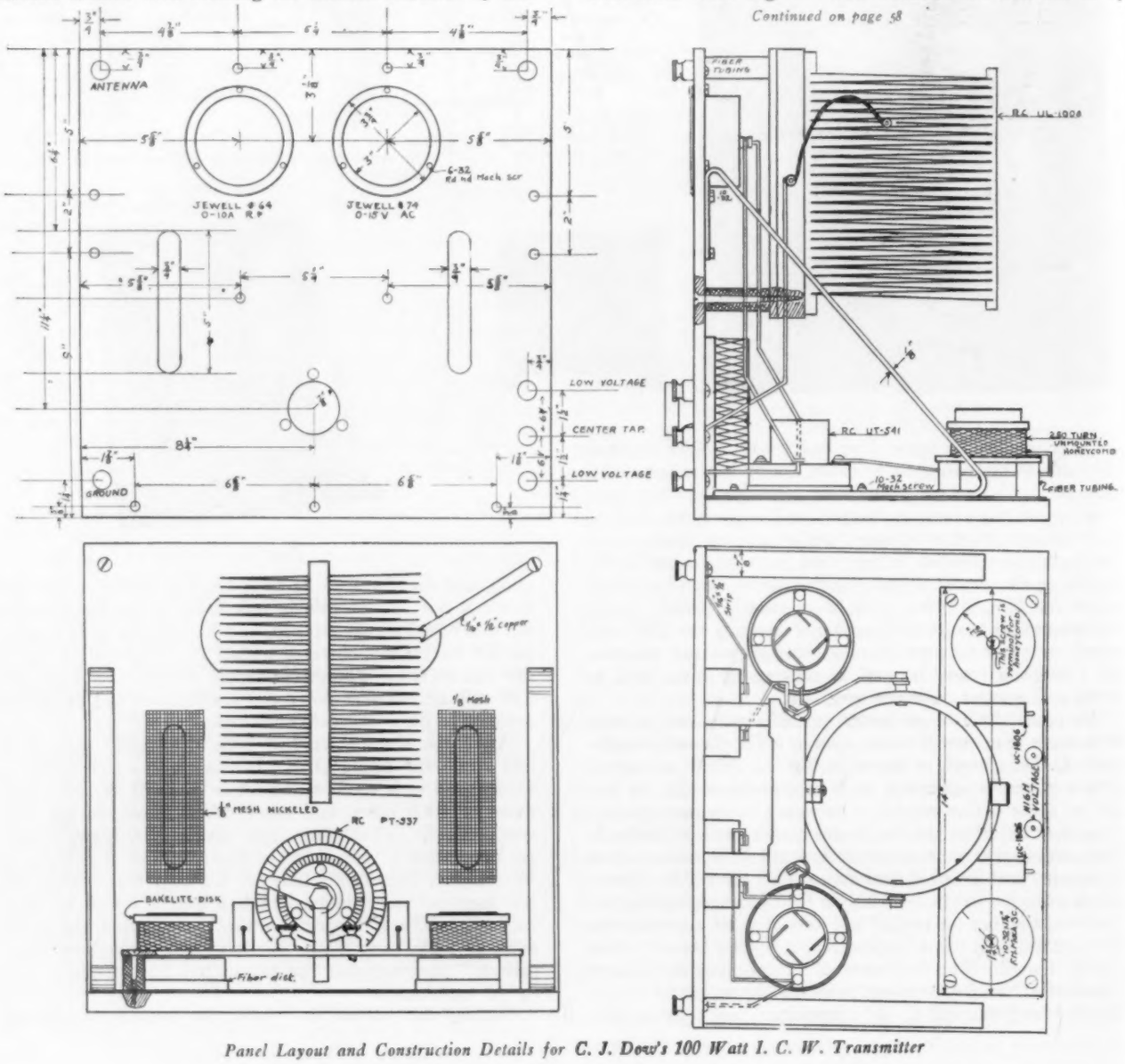
The panel is made of 3/8 in. bakelite, formica or condensite 16 in. by 16½ in. If a polished panel cannot be obtained it may be finished by sanding with No. 1 sand paper wrapped around a block of wood. A block of cork or hard felt is better (or a black-board eraser if one is at hand) than wood, as backing for the sand paper.

When the surface presents an even dull appearance it should be rubbed with pumice and kerosene, a felt pad being used. After washing with gasoline the final polish is obtained by rubbing with rotten stone and raw linseed oil.

This process is rather laborious and should be resorted to only in case a finished panel cannot be had. A pleasing satin finish may be obtained by having the panel sand-blasted at any glass beveling works at a cost of fifty cents.

The holes may next be laid out and drilled, taking all dimensions from Fig. 1. The windows are best cut in by

Continued on page 58



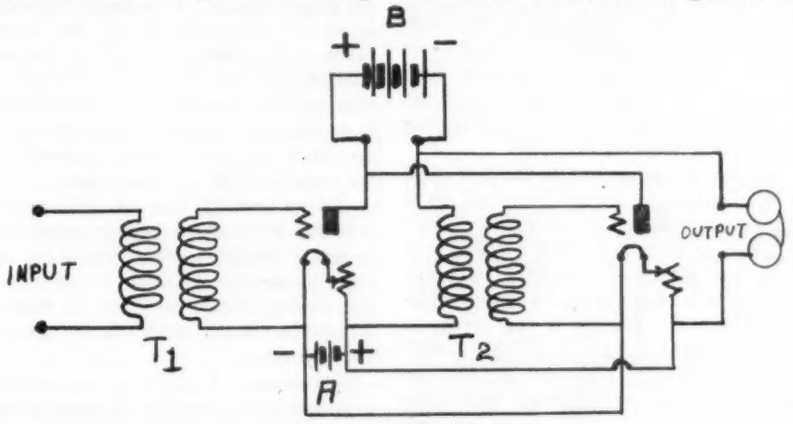
Panel Layout and Construction Details for ***C. J. Dow's 100 Watt I. C. W. Transmitter***

How to Make a Two-Step Amplifier

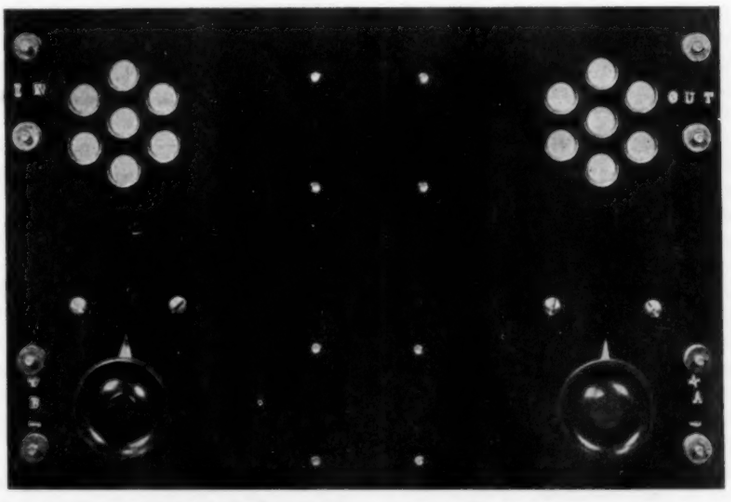
By D. B. McGown, Assistant Radio Inspector

WHEN the receiver which was described by the writer in March RADIO has been completed, tested, and found to work satisfactorily, the owner thereof will find that it will not be sufficient to get all the radio telephone concerts and broadcast matter as loud as he would like to have them. The need for an amplifier becomes apparent at once, and is the only solution to the problem.

The exact design of the amplifier, as well as the detailed circuit used, is given herewith, and is shown in the accompanying cuts. It is not possible to construct as much of the amplifier as it was with the tuner, so the work becomes largely a job of standard parts. Some of these parts, such as sockets, rheostats and binding posts, could be easily made if one had a complete machine shop, but usually such tools as are required are not available, and furthermore, the time expended on the actual manufacture would be so great that it would be a better plan to buy the parts anyway, if the builder's time is worth anything at all.



Amplifier Circuit Diagram



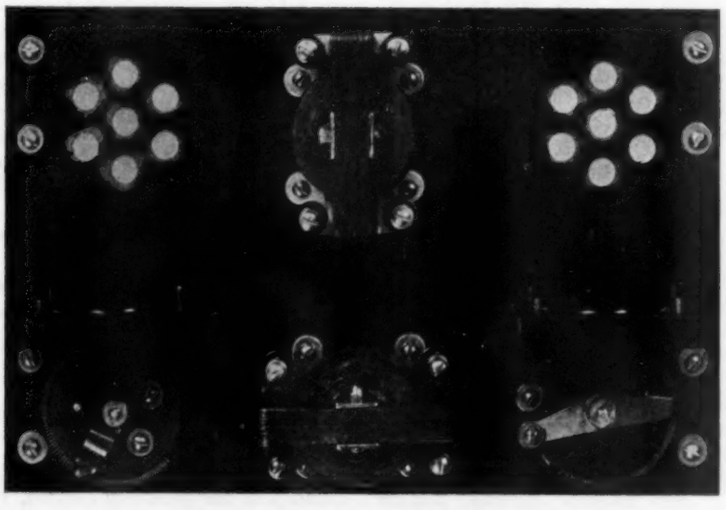
Front View of Completed Amplifier Panel

For most purposes a "two-step" amplifier will be found to be satisfactory and capable of giving loud enough signals to render the music audible to all. For this instrument, we will need the following:

1 panel of convenient size and thickness.
2 amplifying transformers (audio frequency).
2 tube sockets.
2 vacuum tubes (amplifier tubes).
2 rheostats.
8 binding posts.
Wire for connections.

The circuit diagram for an amplifier of this type is shown herewith. The posts marked "input" are connected to the primary of the amplifying transformer on one side, and the current from the pair of binding posts marked "telephones" on the detector panel forms the external circuit, in this case. The two binding posts at the upper left are the ones used for this purpose. There is then a current induced in the secondary of the transformer, T_1, whenever a signal passes thru the primary. This in turn affects the grid of the first amplifier tube, whose output goes to the primary of the second amplifying transformer, T_2, and from the secondary of the secondary of this, to the grid of the second tube. The telephones are then connected to the output circuit of this tube, as shown. Binding posts for use for this class of work are mounted on the upper right side of the panel, opposite the posts marked "input," but the telephones connect to the "output" posts. Two lower sets of binding posts are also shown, one pair on each side. One pair is used for the A battery, and the other for the B battery.

The same batteries may be used for the amplifier as are used for the detector tube, but they should be taken care of, and not allowed to run down, which they will do very easily if abused as the amplifier takes considerable more current than the single detector tube. When making the connections, it will be found that there is one post of the filament circuit which need not be connected with the A battery. This, if everything is



Rear View of Completed Amplifier Panel

connected right, is the negative lead, and this post may be left open. This circuit is already made within the detector set itself, and if connected thru the amplifier as well, simply means extra work for nothing. This only holds true when a common battery is used for the filaments and plates, of course.

The common method of using "jack" and "plugs" to switch into the detector, and various different steps on the amplifier have been abandoned in this particular type of amplifier. In most cases persons listening in to concerts will never use less than two steps, and the extra expense and trouble of installing jacks is scarcely worth while.

Instead of the output of the last stage of the amplifier being connected to a pair of telephones, a "loud speaker" may be substituted, which, with a horn, will allow the music or telephone or other received conversation to be heard without difficulty. If this is too weak, it may be necessary to add a third "step" to the amplifier. This may be done by adding another transformer and tube and rheostat, etc. The input of this transformer will then go to the point where the telephones are now connected, and these, or the loudspeaker, may be connected in the output of the third tube. It is not advisable to carry the amplification farther than this, in most cases, as the extraneous noises usually introduced are magnified by each succeeding amplifier until more "noise" is heard than signal.

The loudspeaker used may be some one of the more elaborate instruments on the market, or a Baldwin receiver attached to a phonograph horn may also be used. Some types of ordinary metallic diaphragm telephones may be used in place of the Baldwin, and almost as good results obtained. The horn may be attached to the receiver in any convenient way. A horn may be procured and taken to a machine shop and carefully and permanently fitted to the receiver, or simpler means may be used. The writer has seen one such loudspeaker made up by taking a telephone and binding the horn onto the telephone with ordinary tape. Not a very fancy looking job resulted, but one that was "workable" was certainly obtained.

RADIOBILITY

The Word You Have Been Wishing For

RADIOBILITY—The quality of the etheric atmosphere for the propagation of radio telegraph or radio telephone signals.

The RADIOBILITY is good when there is no interference from atmospherics or fading.

Originated by W. Harold Warren, 2AVO, 605 Munroe Avenue, Asbury Park, New Jersey.

How to Operate a Receiving Set

By Malcolm P. Hanson, Chief Radio Operator University of Wisconsin

OWING to the sharply tuned waves of radio telephone signals, their reception at a distance usually requires careful adjustments of the receiving circuits, and is not accomplished as readily by the novice as is the reception of spark telegraph signals. In view of the differences of manipulation of the various types and makes of receiving sets, it is possible here to give only a general outline of the procedure to be followed. For complete operating instructions, the receiving operator should consult the manufacturer of his apparatus.

Before signals can be received, the detector must be in proper adjustment. Mineral detectors are adjusted by varying the pressure and spot of contact on the crystal until the note of the test buzzer is heard most clearly through the phones.

Gas-content (soft) detector tubes are adjusted by raising the filament current gradually, until a slight hiss is heard in the phones, and then reducing this current until the hiss just stops. Care should be taken during this adjustment to set the regenerative inductance or tickler coil at its minimum value. The plate (B battery) voltage at the same time should be so adjusted, by means of variable battery taps, or preferably by means of an A battery potentiometer, that this hiss commences at as low a filament current as possible. Most gas-content detector tubes require a critical plate voltage somewhere between 18 and 22 volts. The adjustment is most easily made by the use of an A battery potentiometer, which connects the negative end of the detector plate battery to any desired point between the positive and the negative terminal voltage of the filament A battery, thus providing a continuous 6 volt variation.

Many operators who wish to avoid the critical adjustments necessary for operation of a gas-content detector tube, find it convenient to employ a hard amplifier tube in its place, at a slight loss of sensitivity. These highly evacuated tubes are not critical in adjustment, and have no "hissing point." The best plate voltage for these tubes when used as detectors is best found by trial, but is not critical.

Amplifier tube filaments are burned at just sufficient brilliancy to give maximum signal strength. Any plate voltage from 45 to 90 volts or even higher may be used on amplifiers, the higher values of plate voltage generally giving somewhat increased amplification.

After the detector and amplifiers are adjusted, the signals desired are "tuned in" by varying the inductance and the capacity of the receiving circuits. Where a separate primary and secondary circuit is employed, the beginner frequently makes the mistake of using too tight a degree of coupling, which increases the condenser.

Signals received are greatly strengthened by use of a regenerative circuit, properly adjusted. To obtain regenerative action, carefully increase the plate inductance or tickler coupling until a slight hissing or hollow sound is heard in the phones, then move the adjustment back slightly until the hissing just stops. If the circuit is functioning properly, it will be found that phone and spark signals can thus be regenerated and their intensity increased many times. The slight hiss just mentioned indicated that the detector circuit is in a state of oscillation; this adjustment should be used for receiving continuous wave telegraph signals, and will also be found advantageous initially to "locate" radio telephone signals from distant stations.

"Locating" radiophone signals is accomplished by careful variation of the tuning while using an excessive value of tickler coupling or plate inductance, i. e., just within the "hissing" region. Continuous wave telegraph signals will now be heard, and phone signals can be recognized by the steady whistle-like beat likelihood of interference from other stations. To pick up a signal, a moderate degree of coupling should be used, and the tuning of both primary and secondary circuits varied until the signal is heard; the coupling should now gradually be loosened, and at the same time the tuning of primary and secondary be slightly readjusted for maximum signal strength. It will generally be found that, with a proper degree of loose coupling, interfering signals and strays may be diminished, without reduction in the strength of the signals to which the apparatus is tuned. Because of their sharp wave, radiophone signals may be received with much looser coupling than spark telegraph signals.

Where a single circuit tuner is employed, the tuning of the desired signals is greatly simplified by the absence of coupling and secondary circuit adjustments. In one well-known make of single circuit tuner, both the inductance and the capacity of the tuning circuit are varied simultaneously, by means of a single adjustment; other makes of single-circuit tuners are adjusted to the desired wave by varying the inductance by steps, by means of a tap switch, and then by careful variation of the tuning note which their carrier wave produces.

The Radio Wave

By Charles K. Fulghum

IT IS certain that the transference of energy which makes possible radio communication, takes place in the form of a wave. What this wave is, and some of the fundamental phenomena associated with its propagation, are presented to the amateur in this article.

Texts usually treat the subject in this light: The amateur is told that radio communication is possible thru the agency of certain waves, these waves being similar to those formed by a drop of water falling into a still pool; that these waves spread out thru the ether; that they are absorbed by the sunlight; *et cetera, ad infinitum*. On the other hand, original papers explaining these waves lead the bewildered amateur thru a devious route of differential calculus and trigonometry, and as far as he is concerned, gets him nowhere. After several years of this is it to be wondered at that the amateur's conception of a "radio wave" is about as clear as mud?

It is true that the knowledge of these waves is very slight and that at the best, we can but advance theories as to what they are. This explanation, of one of those theories, was adopted because to the writer it seems the most plausible and would be best understood by the average reader. The writer sincerely hopes that, after reading this article the amateur will at least dispute the validity of this theory.

Wave motion may be defined as a periodic, undulating motion which takes place in an elastic medium, due to energy being periodically supplied to some portion of that medium. For illustration we may fall back on that given in texts. Thus, if a stone is dropped into a still pool of water, waves will be formed and these will spread from the point of disturbance in all directions. If a point is chosen beneath the surface of the water, and a careful study made under the conditions which take place in this medium during such a disturbance as cited above, we find that the water is not moved along, but is merely compressed and rarefied, corresponding with the wave motion which takes place on the surface. One such period of rarefaction and compression, which may take place in any medium, is known as a "wave." Wave length is measured from any point in one such "compression" to a like point in the next.

From waves in water to waves in air is but a short step and we find that waves which are formed in this medium are similar in many respects to those formed in the water. Characteristic of these "air waves" are the waves which cause sound. A disturbance which will cause sound "breaks" up the atmosphere into a series of rarefactions alternating with points of compression which move outward from the point of disturbance thru the atmosphere until the energy of the wave train is dissipated, probably due to molecular friction. Thru the work of a number of scientists we are able to photograph these sound waves and study their formation and determine the fundamental phenomena associated with their propagation. Notable among these men is Professor Foley of the University of Indiana. A study of sound wave photographs made by his method was undertaken by the writer a short time before this article was prepared and some of the conclusions arrived at in the explanation of radio waves which follows are based on the characteristics of sound waves, methods of formation and their propagation thru various media.

THOSE familiar with electro-statics know that, when two plates forming a simple condenser are charged, the dielectric separating these charged surfaces is in a strained condition. This can easily be proved by examining a dielectric of glass with a polariscope when the dielectric is between two highly charged surfaces. It is evident that if the dielectric separating the conducting surfaces is a medium such as air, this stressed condition will not confine itself to that portion of the medium which lays between the plates, but will extend for a considerable distance beyond them. If we increase the area of one of the plates and keep other conditions the same we find that the stressed condition is more apparent near the surface of the enlarged conductor. If the larger conducting surface is formed of a variety of materials whose coefficients of conductivity vary widely, the "field of stress" over these different materials varies proportionally.

It is now evident that the surface of the earth can be considered as the plate of a huge condenser and the antenna of any radio station as the other conducting surface. When the antenna is charged a stress will be produced which theoretically can be detected at any place on the earth's surface.

Were the earth's surface of uniform conductivity, the amount of this stress would be diminished as the square of the distance from the radiating antenna, equally in all directions. It is also evident that the velocity with which this stress spreads over the surface of the earth will equal the velocity of electricity.

It can be shown that if an electroscope is introduced into the "field of stress" between the two charged plates previously mentioned, a displacement of the indicator will be caused, showing that a charge has appeared on the metallic portion of that instrument. The same is true of the earth forming the plate of a huge condenser. If we erect an antenna in such a "field of stress" a charge will appear on it. Why we are able to differentiate between the "field of stress" that various transmitting stations create necessitates an explanation of wavelength.

If the velocity of waves passing a point is uniform, the number of waves that pass that point in a given length of time will depend on the length of the waves. Thus, supposing the waves to be of uniform length and their frequency is lowered; i. e., the number of waves formed per unit of time, the wavelength must be increased and vice versa.

Since the current which flows in the antenna system of a transmitting station is an alternating current of radio frequency, a similar variation will be caused in the charge which is induced in the antennae of receiving stations which lay in the "field of stress" created by the transmitting station. If this charge is to cause a current to flow in the antenna of the receiving station (which it must do if we are to detect it), the impedance of this circuit must be reduced to zero for currents of a frequency equal to that of the transmitting station. This is what is done when a station is "tuned in." It is apparent that if a transmitting station varies in frequency while "working" another station, it will cause much trouble at the receiving station. This is the case with certain types of arc and spark transmitters where the current is constantly varying slightly. Such stations cannot be sharply "tuned in," and they cause any amount of trouble for all receiving stations that lie in their vicinity. Mention of these types of transmitters will be made later in connection with the distances covered when dealing with various methods of producing the radio frequency currents for the transmission of intelligence.

PRACTICALLY all of the phenomena of radio communication have to do with the distances covered by the transmitting station. These phenomena have been divided into two classes. The first deals with the radiation system; the types and directive properties of various antennae, and the sources of radio frequency currents and their qualifications.

The second class has to do with cosmographical influences and their effects on the "field of stress."

Continued on page 46

Grid Leaks

TRUE STORIES OF THE WIRELESS

By EARL ENNIS

John S—— dropped in on a friend one night, and for the first time, heard a radiophone concert. From that night on he was a changed man. He haunted wireless shops. He priced instruments. He studied catalogues. Finally, one day, even as you and I, he fell. Walking boldly into a store, he bought a complete set and marched jubilantly home with it under his arm.

That night he placed the set on the table in his living room while his family collected around him and marveled. He fastened the phones just where the man had shown him. He turned on the lamps. He heard a sound in the receivers like mother frying a steak, or a wet sock broiling in front of the fireplace. That was all he heard, no matter how hard he turned the knobs.

In despair John crossed the street and hunted up a boy who owned a home-made set worth about eighty-five cents, Mexican money. The boy came over. John asked him technical questions.

"Ain't my battery all right?"

"Sure," said the youth.

"Ain't I got enough lamps?"

"I reckon."

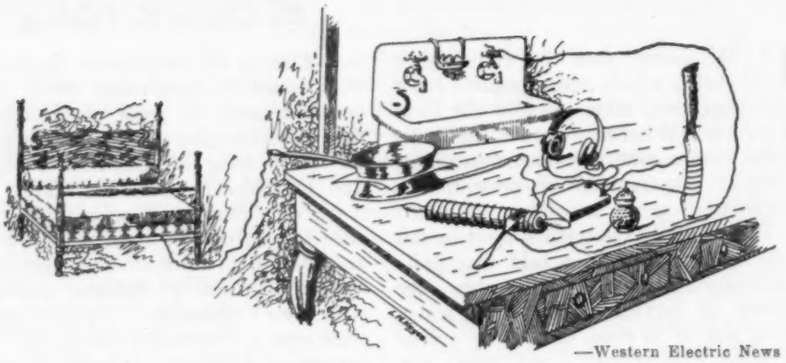
"Then what's the matter with the set?" demanded John.

The boy scratched his nose with a reflective finger.

"Well," he said, "I don't know how it is with your set. But mine works better when I got an antenna connected to it. . . ."

Why don't you put up an "Umbrella" aerial?

Ah! I hear they leak too much!



—Western Electric News

The Home-Brew Set

BROADCASTING OPERATOR: "That last piece was 'Sweet and Low' by Al. McGluck, the Irish tenor, a victorious record. Just a moment, please . . . We'll have a two minute intermission. . . . . I'm glad you're all enjoying the concerts. The next will be a prayer. Let's go!"

SOME RADIO VERSE

By EARL ENNIS

ROUGH STUFF

There was a funny little guy,
Who took up radio;
He bought a fancy tube set
But he couldn't make it go;
He clamped a piece of crystal
Beneath an old bent pin,
And made his own detector, and
B'gosh, it brought 'em in!

• • •

RADIO GOOSE RHYMES

Sing a song of wireless,
A table filled with junk;
Four and twenty-hook-ups,
Mostly all the bunk.
When the music's going,
And the voice comes in,
Isn't it a merry thing to realize that the blamed set is working in spite of the fact that the antenna is connected to the B battery?

When They Transmit Power via the Ether!

"Pretty maiden, chic and gay,
QRD for a swell cafe;
QRK, Oh dainty she?
Wilt thou shake a foot with me?"

"QRM," the maiden said,
As she coyly tossed her head.
"QRW—I cannot go;
QRZ—my answer—no!"

"Pretty maiden, how you vex!
QRV? And QRX?"
"Stand aside!" the maid's decree.
"QRU—don't fool with me."

• • •

GIMME

Maid of Athens,
E'er we part—
Give, Oh give me,
Back my heart;
Gimme back my honeycombs
Gimme back my diamond ring;
Gimme back my two-step too,
My Baldy phones and everything.
Maid of Athens,
You're tuned out;
I liked 'em lean,
And you got stout.

• • •

THE AERIAL

The wires I've strung for thee, dear set
Are like a shoe-string gambler's bet—
Each strand a sob, each sob a pain,
No sooner up than down again.
I cinched you like a fiddle string
And in the house the lead I'd bring,
And every time a high wind blew
And something snapped, I knew 'twas you,
My aerial! My aerial!

• • •

Abbreviations are used in radio communication to save time. The same abbreviation is used for answer or notice as for the question. Thus as a question QRM means "are you being interferred with," and as an answer means "I am being interferred with." It is regularly used to denote interference just as QRN denotes atmospherics or statics. QST means "will you forward the radiogram"; QRD, "where are you bound for"; QRK, "how do you receive me"; QRW, "are you busy," or "I am busy"; QRZ, "are my signals weak"; QRV, "are you ready"; QRX, "shall I stand by"; QRU, "have you anything for me," or conversely, "I have nothing for you."

A Phony Freeze-Out

By Volney G. Mathison—*A Samuel Jones Story*

"WIRELESS operators are a thing of the past," breezily proclaims Mr. Aloysius Bean. "Thanks to our wonderful new Hellkum wireless telephone, the time has come for the telegrapher-tourist to fold up his license and go to work."

Hell-Fire, Old Judge, an' myself, sittin' at our interrupted poker game in the Unga wireless-shack, receive this calamitous news in wonderin' silence. From our window overlooking the bay, we had seen th' mail-boat come in to dump off this tortoise-spectacled bird along with a lot of boxes an' crates; an' while we had been sort of wonderin' who an' what he was, th' cards had been runnin' too good to allow our attention to get deflected off th' jack-pot into any idle speculations.

"Well, personally, I ain't much concerned, mister," I remarks, calm-like. "I'm now livin' as a gentleman 'a leisure—that is as long as th' codfish-snailers' cash an' my poker-luck hangs out—but I'm kind'a sorry fer Old Judge an' Hell-Fire, here, an' all th' rest of th' brass-pounders scattered along this Alaska Peninsula. There must be twenty or thirty of 'em."

"Twenty-eight," rejoins Mr. Aloysius Bean, complacent-like; "there are twenty-eight radio stations in this Bering-Sea region owned by the various salmon and codfishing concerns; and we are going to install one of our latest model radiophone sets in every one of them. The apparatus is already here, and also five installation experts, including myself, to put it in. In three months there won't be a wireless operator left on the Alaska Peninsula."

"Zat so!" barks Hell-Fire, jumpin' up, with one hand under his mackinaw an' a bad look in his eye. "Say, you better vamoose, you——"

"I don't know if I got you straight, mister," I says, landin' Hell-Fire a hard kick on th' shin, meanin' for him to keep his shirt on. "Th' idea is that all these cannery companies are goin' to use wireless phones an' do away with th' operators?"

"Exactly," replies Mr. Aloysius Bean, still wearin' his irritating smirk, but watchin' Hell-Fire pretty uneasy-like out of the corner of his eye. "On account of it being such an isolated region, the owners have been given permission to run their own phone sets, without operators' licenses."

"But how are they goin' to handle all the business to an' from th' States?" exclaims Old Judge, who I can see is badly worried about his berth at K-V-I. "That is our main traffic, an' it all has to be sent to th' naval stations for relaying, either way."

"That night Fat tries to make a get-away, but he stumbles over a wash-tub full of dirty dishes."

"That has all been taken care of," replies Mr. Aloysius Bean, smoothly. "We have made arrangements with the navy department to install one of our radiophone sets in the naval station upon the Pribiloff Islands, which all the fishing companies will jointly pay for. This will make it a simple matter to handle business that has to make the Alaskan navy relay to outside points."

"I HAD a hunch that guy was gonna mean trouble, th' minute I lamped him," glooms Hell-Fire, when Mr. Aloysius Bean has departed in company with the Brainless Swede, the fish-boss for the codfish company who own K-V-I. "Some people got a crust, sayin' Alaska still has a touch 'a th' western days 'a forty-nine, when a google-eyed combination of a two-by-four wireless pole an' a fizzled B-battery like that can land on these shores, an' live. I tell ya, this country's goin' to th' dogs; th' time is comin' for all us real westerners to shove on to Siberia——"

"He'll prob-bly come out to th' dance Saturday night; an' you kin frame it up to start a fight with him fer dancin' with your best girl, an' knock his block off," suggests Old Judge, hopeful-like. "Soapy Komedal was grumblin' th' other day that he hasn't sold a tombstone for three weeks—an' if th' marshal brings you in, I'll throw it out 'a court as bein' a case 'a *dux femina facti*—which means, Th' Cause of it was a Woman."

While Hell-Fire an' Old Judge are plottin' the legalized extermination of Mr. Aloysius Bean, personified black plague on brasspounders' meal-tickets, I am doin' some complicated thinkin'.

"You're too previous with all that six-shooter talk," I informs 'em. "This vacuum-tube stuff is bound to come—an' it's a good thing. Here we've got a bunch 'a out-'a-date stations, made up with all kinds 'a rotten old junk scrambled together, some of it workin' bum, an' th' rest of it worse. Now we get brand-new sets, all uniform, an' th' latest thing in radio. We want them tube sets to go in—we need 'em."

"Where do ya get that *we* stuff—are ya tryin' t' double-cross us!" flares Hell-Fire. "Once them talk-to-hellenbak wireless phones are in, *we* are out—out like a bunch of old battle-ships hit by a shower of advance spring fashions in airplane bombs!"

"Your mental perambulations are about as graceful as a Missouri rube runnin' to a fire with his feet caught in a barrel-hoop," I retorts, coldly. "There's several things about this scheme which I can see haven't been figured on. Th' key-punchers may be ostracized from th' payroll an' th' ol' grub-shack fer a while—but not long. We been strugglin' here long enough with shot-up condensers an' ear-splittin' interference. Let th' tube sets go in!"

"All right, Mr. Conqueror 'a Ouglamuck," growls Hell-Fire, sour-like. "Wel'l let 'em—I s'pose we can't do nothin' about it, nohow."

THEY were dazzlin' sets. A heavy bakelite panel carrying the controls an' meters, a rack full of the finest C. W. apparatus ever built—an' four glistening 250-watt power-tubes. Using the latest thing in power-amplifier circuits, they are built to work on three-phase alternating current, without rectifiers, an' use no big modulator tubes.

On a separate base, designed to be belted to the gasoline-engine of the old spark outfit, is a triple-generator set, which furnishes filament currents, a thousand volt current for the small master-tube circuits, and a three-phase alternating current, stepped up through a transformer to 2500 volts, for the big power-tube plates.

A light handled microphone-transmitter is hooked up to the panel with a long cord; and a desk push-button operates an automatic aerial-switch and also controls a special circuit to ease the voltage-shock when the big tubes are set to work. After the apparatus is adjusted, there seems to be nothing to do but push this button to talk or to listen in on the snappy three-step amplifier receivin' set.

They look like fool-proof outfits, and we hear that after they are all installed, Mr. Aloysius Bean is goin' to stay an' travel around from station to station as a maintainence expert, to keep 'em perkin'.

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A GOOD OPERATOR!

Thinks twice before he starts up.

He listens to what is going on on the wave he is going to call on, and also on the wave of the station he is going to call, if different from his own, before he calls.

He stops to think whether the station he is about to call is on schedule with someone else, or listening to QST on another wave, or for any reason may not be on his regular listening wave, or may not be on watch. (Ships should be furnished with working schedules of all stations for this purpose.)

He never answers hams who he knows want to chew the rag or do unnecessary communicating.

Never makes unnecessary signals.

Doesn't indulge in the ham practice of making dozens of meaningless signals, i. e., attention signals, Vs Ks GAs, finish signals, etc. A transmitter is for carrying on communication with, not for making a noise.

Knows and uses the international abbreviations, and when it is necessary to use plain language, doesn't spell everything out in full, but uses Phillip's code abbrevations.

Never calls a station who has just finished calling some other station, until the calling station has a chance to listen and see whether the station called answers him.

Doesn't call continually with no appreciable interval between calls. If a station doesn't answer, there isn't much use calling again in half a minute. Wait at least five minutes unless you are sure you are well within range and that the operator you are calling is on watch and not QRW.

Always uses lowest power.

Reduce your power while you are working a station till he says QRZ, then increase a little.

Decreasing your voltage is not sufficient to decrease the distance you are heard, and the consequent QRM you cause. Cut down the gaps simultaneously with the reduction of voltage. You may be surprised how far you can work with a third the number of gaps you have been using.

If you call someone on medium power and QRM comes in or you begin to fade to him, you can then increase power if you don't keep your set crowded to the limit all the time. It's better not to raise a station quite so far and be able to have some power when he calls for more, than it is to raise him with the limit of power at the limit of range and cause twice as much QRM trying to work him QRZ, and then stand a chance of not getting the biz off.

Always shifts wavelengths when possible.

Never tries to pound through QRM on 600 meters and cause still more by doing so, when he has other waves at his disposal. A lot more work can be done on 300 and 450 than many operators think.

Uses QSY waves whether there happens to be anyone else in on 600 or not. Someone else may be waiting for the air to clear up, and you never can tell who you are interfering with, even though you may not be able to hear them.

Considers 600 meters more as a calling than a working wave. The ship calling wave should be reduced to about 450 or 500 meters so that a station could QSY to longer waves when his calling wave signals were weak, and to shorter, more inefficient waves (for the average ship antenna) when his calling wave signals were loud. This would insure a station always being able to clear a station which he could raise on his calling wave. Ships should also be equipped with more waves, say every 50 meters from 300 to 650, tuned sharp and exact. There is too much work being crowded onto 600 meters.

Never sends faster than the man he is working.

The speed at which an operator works you is the speed at which he would probably prefer you to work him.

Doesn't ask for unnecessary QSRs.

QSR is a common cause of QRM. Why put a message on the air two or three times with its attendant repeats, fills, etc., and cause correspondingly more QRM when you can probably get it off yourself by waiting a little.

With a high power set has consideration for small stations.

The fellow with a small voice may be just as good an operator or better than you are. Anyway, he's human and trying to hold down a job and get his business through just like yourself.

He never tries to work through someone else because he knows he can. He waits his turn.

Keeps his set tuned sharp and with a good note.

Get your power on one wave and work twice as far with less QRM for the rest of the stations.

A good note gets more answers, does more work, and bespeaks a good operator.

Never gets personal over the air.

It doesn't do any good.

Is always on the job for calls on whatever wave he is supposed to be on.

Doesn't stand his radio watch in the galley.

Listens in with his bulb oscillating.

And picks up five times as many calls.

Doesn't pass the buck.

When he is "called down" for something, doesn't begin to blame it on the "navy operators," "Japs" or the fellow on the other end. BE sure your failure is not due to your own work first.

Sends good stuff.

Some operators do. A few can't. Most can, but don't.

Keeps up to the radio times and the advancements in the art.

And all the little kinks and tricks that make the other fellow's work easier or improves his own service.

WHERE DOES HE LIVE? Show him to me!

TRANSMITTING ON GALENA

By L. F. SEEFRED, Radio 6EB

I presume most of the fellows interested in radio know by now that one can transmit on their own receiver by making the bulb oscillate. Tune the set until you get on the "beat note" or "carrier wave" of another amateur station, and then insert a key in the ground or antenna lead and work with him. Here in Los Angeles when this system was first used by just three or four stations, the fellows used to have quite a system of secret communication. But so many know it now that if one tries to talk by these means, it causes QRM! However, this could be done in a smaller city with ease, but be sure your wave does not exceed *200* as it will result in some *other* kind of fun.

Now as for transmitting on galena, is something that everyone does not know. It is just as simple. One day while I was having my storage battery charged, I decided to "dig" out the old galena set to see what could be done on such a set these days. I tuned around and finally succeeded in picking up the "beat note" of some fellow's receiving set. Later I heard him sending to another one on the same wave. I immediately inserted a telegraph key in the ground lead and made several dots and dashes to see if I could break them. Sure enough, one of the fellows said to the other, "QRX, some one else is on our wave." They both immediately stopped and I gave one of them a call. He answered, and when I told him I was sending on galena, he began to have the —what you would call "250 wattitus." After that, we three talked together on this system most every night. The whole idea is that their receiving tubes would have to be heterodyning on each other before I could talk to them on galena. But just as soon as one of them would turn off the bulb, my transmitter would be dead!

An electron is the smallest known quantity of negative electricity. A negatively charged body is one having more than its normal number of electrons, and a positively charged body is one having less. An electron in motion constitutes an electric current. This motion is always from a place of high to a place of low pressure, the difference in pressure being known as voltage.

A Radio Primer

By H. A. Eveleth

AERIALS

THE functions of the aerial, or antenna as it is often called, are twofold: when used with transmitting apparatus it radiates energy in the form of ether electromagnetic waves and when used with receiving apparatus it absorbs energy from ether electromagnetic waves.

We say electromagnetic waves because these waves have electric and magnetic fields, at right angles to each other, similar to the electric and magnetic fields set up by a current flowing through a wire. Electric currents are set up in the windings of a dynamo or generator when the windings are made to cut magnetic lines of force by the rotation of the armature on which they are wound. The effect would be the same if the armature were stationary and the electro-magnets which form the pole pieces were revolved about the armature. It is therefore apparent that we may generate an electric current by either moving a conductor in a stationary magnetic field or by moving a magnetic field about a stationary conductor. The receiving aerial is a stationary conductor placed in the path of a moving magnetic field, this magnetic field being one component of the advancing ether electro-magnetic wave radiated by a transmitting aerial. A current will therefore be set up in the receiving aerial and suitable instruments will change this energy to sound waves which can be heard.

The material of which an aerial is composed should be a good conductor of electricity and of good mechanical strength, especially in country where it would be subjected to an accumulation of sleet. No. 14 stranded phospher bronze wire is perhaps considered the best, but stranded copper wire of the same size will answer every purpose. Stranded wire has a larger surface area than plain wire and is a better conductor of currents of high frequency. It has already been explained that radio frequencies vary approximately from 2,000,000 to 15,000 cycles per second. Now a peculiar thing about high frequency currents is that they tend to flow near the surface of a wire and the higher the frequency the nearer they stick to the surface. Hence we use a stranded wire in aerials to give this high frequency current more surface or area over which to flow.

Aerials used for transmitting purposes should be carefully designed and on account of the high voltages to which they are subjected must be thoroughly insulated from the ground or from grounded objects.

Receiving aerials require much less insulation because they carry currents of very low potential and as much care need not be put into their design. In fact messages can be received, with suitable apparatus, on almost any non-grounded metallic conductor from a bed spring to a fire-escape or even the metallic frame of a spread umbrella. Seriously speaking, it is now possible to enjoy radio music while you lie in bed, hang out clothes or walk or ride about the streets.

The wavelength at which a sending station operates depends in part on the size and form of the transmitting aerial. Hence a station, desiring to use a certain wavelength, must design its sending aerial to approximate that wavelength and final adjustments can be made in the sending apparatus. We will explain later just how the wavelength can be varied, that is, how a given wavelength can be obtained.

Amateur stations are limited by law to a transmitting wavelength of 200 meters, hence an amateur's sending aerial must necessarily be comparatively small. Commercial ship stations operate on about 600 to 800 meters, using a larger aerial than amateurs, one stretching between the masts. Shore stations have room for much larger aerials and operate on wavelengths from 1000 to 1500 meters, while the transoceanic stations, using aerials often a mile in length and 400 to 600 feet high, operate on 5,000 to 20,000 meters wavelength. While a short aerial radiates more efficiently than a very large one, there is less absorption on long waves than on short waves and the longer waves are therefore used to cover great distances. The wavelength is not the range of the station as some people believe. A station on 1000 meters wavelength will transmit many times 1000 meters in distance.

The small aerial which the amateur uses for sending will receive practically all wavelengths when used with suitable apparatus, but to receive the higher wavelengths efficiently he should use a longer aerial. Hence some amateurs use two aerials; a short one for sending to and receiving from other amateurs and a long one for receiving long wavelengths.

A transmitting aerial should have both height and capacity. The higher the aerial the more efficiently it will radiate energy in the form of electromagnetic waves, and the greater the current in the vertical part of the aerial the greater will be the amount of energy radiated. Height is secured by placing the aerial as high above the ground as possible. Capacity is obtained by stringing a number of wires in parallel and connecting them together at one or both ends. A conductor having capacity can store electrical energy, hence the parallel wires of an aerial have electrical capacity, that is, they will receive a charge of electrical energy. The effect of capacity at the end of the vertical part of the aerial is to increase the current in the vertical section which, as stated above, results in a greater amount of energy being radiated.

The "T" aerial is often used. This consists of one or more horizontal wires with the vertical part or "lead in," as it is called, attached at the center. This type of aerial gives good capacity for the amount of wire used, but it sags in the center, decreasing its effective height, and it is subjected to high potentials at both ends.

The inverted "L" aerial is very popular. It consists of one or more horizontal wires with the "lead in" taken off at one end. The farther end is subjected to high potentials. When the horizontal part is much longer than the vertical part it transmits more strongly in a direction opposite to the free end and receives better from the direction in which it sends best.

The umbrella aerial consists of wires running from the top of a mast like the ribs of an umbrella. It is a good type to use where space permits and is often used with portable outfits.

The loop aerial is so arranged that two "lead ins" are brought to the receiving apparatus instead of one. It is used principally for receiving in connection with portable sets, in places where larger aerials cannot be erected and in cases where it is desired to eliminate atmospheric disturbances and other sources of interference.

The aerial must be connected to another capacity through the sending or receiving apparatus so that the high frequency currents can flow or oscillate back and forth between the aerial and the second capacity. This second capacity is usually the earth, but when a good "ground" cannot be had a net of wires called a counterpoise is spread on or buried in the earth. A water pipe is the usual ground connection.

In the case of an aeroplane the aerial may be a wire trailing or a loop aerial placed between the wings or a "skidfin" aerial placed above and insulated from one of the wings. The second capacity or ground consists of the metallic work of the plane connected together electrically. The trailing wire is the best, but it has to be reeled in rapidly before the plane lands.

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Radio Storage Batteries

By D. B. McGown, Assistant Radio Inspector

This article is different from the usual kind of catolog information about storage batteries. It gives information in simple terms that will enable anyone to take proper care of either lead or nickel-iron batteries. It also tells the why of what is done so that the radio operator need not "work in the dark."

ONE of the most important classes of apparatus used in a radio station, outside of the actual transmitting and receiving instruments, is the storage battery equipment, both for auxiliary power supply to the main transmitter and for various other purposes. One of the largest single uses of storage batteries is on shipboard stations for "emergency" purposes.

There are two broad classes of storage batteries, the lead plate and the Edison "nickel iron" battery. Both types possess their individual advantages, and some may be better adapted to given conditions than others, and these conditions, as well as the cost, are usually the determining factor in the purchase of batteries by a ship owner, coupled, of course, with the ability of the salesman who is trying to sell the batteries.

All ships which carry 50 or more persons are required to have some source of power independent of the vessel's main power supply, which will be capable of operating the set for a four hour period, in case of emergency. Storage batteries are employed almost universally on all vessels, as until recently there was nothing else that would function with such ease and certainty. A gas engine driven dynamo, which may be easily started from a storage battery, has recently been developed, and may prove to be equally as efficient. The law requires that the power be available a few minutes after the need for it becomes urgent in the radio room, which prevents the use of an auxiliary "donkey" boiler, which could possibly be used, if unlimited time was allowed in getting the power. Thus, even with the gas engine driven equipment, we are not free from the use of storage batteries.

Lead batteries of modern type are always made with the so-called "pasted" plates. These plates are castings of lead, sometimes with a small amount of alloy added, made in the form of "grids," i. e., they are made up in the form of leaden frames, which have a large available surface, which surfaces are so designed that a "paste" made up of lead compounds, may be applied to the grids, and this paste is then held in firm contact with the lead grid by their peculiar mechanical construction. There are two plates in the battery, the positive and negative. The paste applied to the positive plate is made of chemically pure red lead, mixed with dilute sulphuric acid, while litharge, also chemically pure, is applied to the negative plate. These compounds are changed in their composition by the "forming" process, which will be explained later. These pasted lead plates are then immersed in a solution made of about 20 per cent chemically pure sulphuric acid and distilled water.

When first set up, after the plates have been made as described, care should be taken to "form" the plates, by giving them several long charges and discharges, often called "forming cycles." This action turns the litharge in the negative plate into spongy lead, and the red lead on positive plate to lead peroxide. This process is reversed during the discharge of the battery, and the acid from the solution enters the plates, and causes the specific gravity of the electrolyte to fall, or in other words, for the acid to get weaker. The actual strength of the acid is measured by an instrument called a hydrometer, which is a small glass tube weighted at one end so as to float upright in the acid. The more acid present, the greater the density of the solution, the acid being heavier than water, and therefore the higher the hydrometer tube will float in the acid. By a simple method of comparison, the hydrometer is calibrated, so it may be used to measure the specific gravity of any acid. The specific gravity is, by definition, the comparison of the weight of a unit volume of water to the weight of a unit volume of the liquid in question, or in other words, if the specific gravity of a solution is 1.225, it actually means that the sample of solution weighs 1.255 times an equal volume of pure water. Pure concentrated sulphuric acid has a specific gravity of about 1.84, and the acid used in storage batteries averages from 1.220 to 1.280 (read "twelve-twenty," or "twelve-eighty"), so it is seen to be much weaker.

The actual value of the specific gravity used in a certain type of storage cell depends chiefly on the use to which the battery is to be put. The stronger the acid, the larger the current that the battery will deliver, for the same size plates, and (in effect) the stronger the acid, the greater the capacity of the battery. This can be easily seen, as the stronger the acid, the greater the amount of active material that can be acted upon per unit time, within limits. If the acid is made much stronger than 1.280, or 1.300 as maximum value, it will be found that the battery will be rapidly ruined by chemical action inside of the cell, which greatly shortens its useful life, even tho no current is drawn out of the battery. On the other hand, if the acid is not strong enough, the battery's capacity will be greatly lowered, without serving any useful purpose.

For automobile and general work batteries are made up with thin plates, and a high gravity acid. The thin plates expose a much larger surface to the solution (which determines the battery's total capacity), and the high gravity gives a large current, which is required for the proper functioning of the starter motor (this current often rises to values as high as 150 or 200 amperes on a 6 volt battery). When such a battery is used, almost all the action takes place at the surface of the plates, while very little action occurs inside of the active material itself.

In radio work almost the other extreme holds. The battery is seldom used, and even when it is, it has no sudden drain which requires every available ounce of "pep" the battery can deliver. If the battery *is* used, a low current of long duration is drawn from it. Generally, the battery stands idle, except for a few short tests, and it usually requires only a small freshening charge to keep it in the best of condition. If a high gravity acid is used in such a battery, it will be found that trouble is almost sure to occur, due to sulphation, sooner or later. The best types of batteries used in radio work, for auxiliary power, have a low maximum gravity, usually 1.220, or thereabouts. When such a battery is discharged, the acid will gradually enter the plates, and penetrate them thoroly, due to the slow action of the low current being supplied, and the full capacity of the battery will be obtained. When the specific gravity has fallen to 1.150, the battery is considered discharged. Further current drawn from the battery will result in the acid entering the lead grids, which will ruin them in time, and also allows destructive compounds to form between the active material and the acid, which prevents the full action of these materials when the cell is functioning normally.

Unfortunately, such batteries are not generally available for installation. A battery of a given capacity will be almost twice as large, and will cost almost twice as much if it is of the low gravity type than if it is of the type using the stronger liquid. This high first cost causes more high gravity batteries to be used than actually should be, altho, with some extra care the high gravity batteries hold up very well.

In order to keep the batteries in good condition continually, arrangements are sometimes made to give the batteries a continuous "trickle charge." This is

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The Vacuum Tube as a Detector

By B. F. McNamee

A simple account of how the vacuum tube works, written for the layman.

THE vacuum tube has become such a commonplace in radio that a complete description is not necessary. The essential parts are a filament, grid, and plate. The filament consists of a wire which can be heated by passing a current through it, as in the ordinary electric light. The plate is generally made of thin sheet metal, usually nickel. The grid is so called because it consists of an open coil or network of wires or metal strips; it is a sort of screen, and to be effective must be placed between the filament and plate. These three elements are enclosed in a glass bulb, and the air pumped out before it is sealed up. Four wire leads are brought out through the glass, one each for the plate and grid, and two for the filament.

Two kinds of filament are in use. The first is a tungsten wire like that used in "mazda" lamps, and when heated to incandescence has the property of emitting large numbers of electrons, or exceedingly small negatively charged particles. The second kind of filament consists of a thin strip of platinum which has been coated with certain chemicals which have been found to be good emitters of electrons. This second type of filament requires only a dull red heat to produce sufficient electrons.

The output circuit of a vacuum tube refers to what is connected between the plate and the filament; it is often called the plate circuit. In Fig. 2 this circuit is seen to consist of a pair of telephone receivers and a "B" battery, the latter containing some twenty or more very small dry batteries, with the positive end connected, through the telephones, to the plate. When the filament is cold, this circuit is evidently open, since no current can flow, inside the tube, between the plate and filament. When the filament is heated, it emits negative electrons which soon fill the surrounding space. But due to the way in which the "B" battery is connected the plate has a positive charge, and in consequence a great many of the negative electrons are attracted to it. This movement of electrons from filament to plate is in reality an electric current, and flows steadily through the output circuit, once the filament is heated. But a steady flow of current through the telephones will produce no sound; to produce sound the current must vary.

The input circuit refers to what is connected to the grid; it is sometimes called the control circuit. For the grid is the control element in the vacuum tube—it corresponds to the trigger on the gun, or to the valve on the steam engine. By making slight electrical changes on the grid, we can make comparatively large changes in the plate current. The electron stream thru the tube, which constitutes the plate current, must pass thru the openings of the grid. A negative charge on the grid will repel some or all of these negative electrons back to the filament, thus reducing the current thru the telephones; while a positive charge on the grid has the effect of increasing the current thru the telephones.

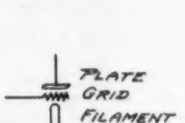

Fig. 1. Conventional Diagram of Vacuum Tube.

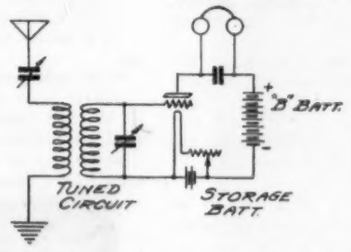

Fig. 2. Combined Input and Output Circuits.

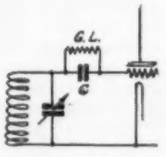

Fig. 3. Detector Input Circuit

It is thus seen that as the voltage of the grid is changed, the current in the output circuit undergoes a corresponding change. We may note, in passing, that a sufficient negative voltage on the grid will reduce the current in the output circuit to zero; this would require a voltage of about one-tenth that of the "B" battery, the exact amount depending on the kind of tube used. This point is not important as we seldom impress such a voltage on the grid.

With some adjustments of filament current and "B" battery, in the circuit shown in Fig. 2, the tube will act as an amplifier but not as a detector. With other adjustments the tube will detect. To illustrate we will suppose that an alternating voltage is impressed on the grid, this voltage changing back and forth between one volt positive and one volt negative. Further suppose that the current in the output circuit is 3 milliamperes when the grid voltage is zero, and that a change of one volt on the grid makes a change of one milliampere in the output circuit. When this alternating voltage is impressed on the grid the output current will vary between 2 and 4 milliamperes, but the average current remains 2 milliamperes as before.

If this alternating voltage is of high frequency, as would be the case in Fig. 2 the current pulsations in the output circuit will be just as rapid, and will not affect the high-inductance windings of the telephones. Since the average current remains the same, there will be no change in current thru the telephones, and no sound will result.

By changing battery values it is possible to find an operating point where the grid control characteristics are so changed that the tube will detect. This is the case when one volt negative on the grid will, just as before, cause a decrease of one milliampere in the output current, but one volt positive will cause an increase of only ½ milliampere. The plate current will now vary between 2 and 3½ milliamperes, or an average current of 2¾ milliamperes. Therefore, each time that a group of waves is received, the plate current will decrease by ¼ of a milliampere, and the diaphragms of the telephone receivers will be moved once. Just as in the crystal detector, the number of movements of the diaphragm per second depends on the number of groups of waves received in one second and not on the number of waves.

Another reason why the vacuum tube detects is as follows: When the grid is positive, it attracts some electrons which do not get through its openings to the plate. This constitutes a current in the grid circuit when the grid is positive; no current can flow when the grid is negative. This amounts to the same thing as connecting a resistance across the condenser each time that the grid is positive, and removing it when the grid is negative. If the circuit is tuned to the incoming signal, and afterwards such a resistance is shunted around the condenser, we will find that it considerably detunes the circuit. So when the grid is negative the circuit is tuned, but when positive the circuit is detuned and of course the voltage is lower. This means greater decrease than increase of output current, or a lowering of the average value, when each group of waves is being received.

The usual detector input circuit is shown in Fig. 3. C is a small condenser and GL is a very high resistance of the order of a million ohms, known as a grid leak. The amount of current flowing in the grid leak of a detector is so small that a lead pencil line on a piece of paper will suffice as a resistance.

When the grid becomes positive it will attract electrons, which can leave the hot

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PROPOSED REVISION OF NATIONAL ELECTRICAL CODE RULINGS ON RADIO INSTALLATIONS

C. W. Mitchell, Board of Fire Underwriters of the Pacific, Merchants Exchange Bldg., San Francisco, as a member of the committee having in charge the revision of the 1923 National Electrical Code, requests answers to the following questions from those interested in radio installations. It is important that these answers be sent immediately to Mr. Mitchell.

RECEIVING STATIONS ONLY

1. What is the maximum height and length or other dimension of aerial that may be considered negligible as far as protective rules are concerned?
   Height from ground?
   Length of antenna or area?
2. Should aerial used exclusively inside of building be excluded from jurisdiction of rules?
   If not, why not?
3. Should relatively low aerial of moderate extent or area, but exceeding the amount excluded from the rules follow telephone practice for protection?
   (a) Should the minimum of protection include a 2500 volt fuse between arrester and interior wiring?
   If not, why not?
   (b) Should the minimum of protection include an arrester outside of building?
   If not, why not?
   (c) Should arrester be permitted to be grounded to water piping inside of building as per telephone practice?
   (d) Should all installations be provided with a switch to disconnect receiving apparatus from aerial when station is not in use?
   Will plugs and jacks be sufficient for this purpose?
4. What height, length or area of aerial should be set as a limit for the moderate protection including lightning arrester, etc?
   (a) Height .....
   (b) Length or area .....
5. Should any device be installed and accepted as proper protection in conjunction with lightning arresters where aerials are exposed to possible contact with lines carrying current at not to exceed 2500 volts to ground?
6. Vacuum arresters:
   What can be done to detect and eliminate defective devices of this character?
   (a) Tests.
   (b) Inspection.

SENDING STATIONS

1. Is there a type of sending station that can be with safety excluded from the rules?
2. Is it possible to classify sending stations on a basis of wavelength or K. W. rating making less rigid rules available for the so-called "low powered installations"?
   For example:
   (a) From 0..... to ..... meters (wavelength).
   Size of aerial lead wire .....
   From 0..... to ..... K. W.
   Clearance of wires from surface wired over ....."
   (b) From ..... meters to ..... meters (wavelength).
   Size of aerial lead wire .....
   From ..... K. W. to ..... K. W.
   Clearance of wires from surface wired over ....."
   (c) ..... meters or over (wavelength).
   ..... K. W. or over.
   Present rules to apply for size of aerial lead wires and clearance.
3. We need a clearer definition of ground switch.
   We use the word "approved."
   (a) Performance test?
   (b) Shall switch be capable of disconnecting apparatus from aerial?
   (c) Base? (design and material)
   (d) Carrying capacity? (cross section, etc.)
4. Clearance of aerial from wires in parallel with it?
5. Arrester..... Shall this device be approved?
   (a) Performance test?
   (b) Shall base include terminals for fuses?
6. Is there any method of installing radio aerial or of equipping a sending station with devices that will reduce inductance to a point where it will not be injurious to adjacent light, power or signal lines without reducing the efficiency of the sending station?

AMATEUR RADIO IN THE EAST

By WILLIAM S. HALSTEAD, 2LH

1SD "breaks thru" fine on spark.

Old 1XE has been changed to WGI.

1BKQ, using two 5-watt tubes, has worked stations in over seventeen states.

1ZE is doing good work on C. W.

1ANQ is reaching out with C. W.

2ASO has installed a C. W. set.

2UA finally succeeded in getting his "cage" up.

2OM still gets messages thru by the dozen.

2BQH is on the air once more with a new C. W. and fone set. Four 50-watt tubes are used as modulators and four as oscillators. The set was on exhibition at the Second District Radio Show.

3ALN, Operated by H. F. Hastings, 905 B St. N. E., Washington, D. C., Who Uses One 50 Watt Tube I. C. W. and Works 6XAD.

2BAK is now WRW. What next?

Broadcasting stations are springing up like mushrooms all over the Eastern states. The following Second District stations (limited commercial) have regular broadcasting schedules:

WJZ, Newark, N. J.
WOR, Newark, N. J.
WNO, Jersey City, N. J.
WRW, Tarrytown, N. Y.
WJX, New York, N. Y.
SDT, New York, N. Y.

2VA is on again.

2EL is keeping his "meat hooks" busy.

2BSC rattles the diaphragms with his spark.

2DK is temporarily dismantled as he is moving back to White Plains. Said Scarsdale was too near Yonkers. 2BK!?

3ZY is very QSA all over the East.

3ZO is doing his usual good work.

Wonder what the President says when 3ALN goes on?

8BRL is pushing traffic thru in fine shape.

4EA handled quite a bit of traffic last month.

4BQ is very QSA on C. W.

4AS has changed from spark to C. W. 'At a boy.

4GN helps to push traffic thru to the South. They say 4FD is on with a 5-watt C. W. set.

4AG may put in a C. W. set—sometime. Still hoping.

4GL is still racing around the ether.

AS THE NEWSPAPERS SEE US

Wuxtra, Wuxtra, Son of Prominent Citizen Installs a Wireless Station and Sends Messages all over the World.

Freddie Greenback, the fifteen year old son of Gogo Greenback, well known literary man, allows himself to be interviewed.

As the reporter knocked on the door a bright looking chap answered the call. He informed the reporter that he was Freddie, so the interview began. Little Freddie led the reporter through half of the rooms in the house and after crawling through a trap door in the ceiling of the back room they at last emerged into the radio room, which was located in a convenient corner of the back attic.

To begin with, said little Freddie, gaze out of the window and take note of those wires strung up between those two poles. They compose the oscillating circuit. They are what are used to pick messages off of the clouds. The higher the wires the greater the moistening. Now take notice of all the other wires which I have hung in the back yard. Those are called the counterweight, and their use is to balance the oscillator and keep it from falling. The counterweight must be perfectly ventilated, so there is a ground on the end of each wire to keep it aereated.

Now take notice of the instruments in the room. All those massive pieces in the corner compose the regenerator, which is the machine that is used for sending. That round box on the wall is a hot water meter, which measures how many miles per revolution my messages are traveling. To make them go faster or slower it is only necessary to change the clips on the fones and the desired result is obtained. All of those black disks mounted on that piece of cooklite are the controls that regulate the kick-back preventer and make it possible for me to hear messages. With that Freddie grabbed up the variable condensers and shoved them on his ears. Then he lit the transmitting condenser and gave the lead-in bushing a twist. Presently he removed the condensers from his head and remarked that NAJ, the broadcasting station of the Westinghouse Electric Co., was sending market reports on a dry wave. Suddenly a booming crash broke up everything, but Freddie said it was only 9BP, one of the Navy's big stations. He remarked that it was sending on a wave of 459 feet, 3 in., which was just about as high as his set would go. As soon as 9BP finished another station came on. This was POZ, one of the local stations in Evanston, Ill. Freddie jumped up and yelled excitedly, "I'm going to call him." With that he closed the grid leak and turned on the variometer. It began revolving at high speed and then he pressed the tickler. A heavy blue spark jumped from the variometer to the two telephones on either side. After doing this for about three minutes he listened again. "OH SHOOT!" he remarked, "he didn't hear me, so I have to call him again." And with that he started up the variometer and began all over again.

9BRE,
C-1 Park Apartments,
Evanston, Ill.

Body capacity effects, whereby closely tuned signals are lost when the operator removes his hand from the condenser dial, can be eliminated by the use of a vernier dial or by gluing a piece of tinfoil on the back of the dial and grounding it. By placing the eraser of a long pencil against the side of the dial and turning it slowly closer tuning is also possible.

News of the Broadcasting Stations

The *Oregonian,* Portland, Oregon, has installed a transmitting set employing the Heising circuit for modulation and the Colpitts circuit for oscillation, using three 50-watt tubes with 1000 volts in the plate circuit. A 60-ft. mast on the *Oregonian* tower gives the 70-ft. four-wire aerial a height of 192 ft. News, instrumental and vocal music is to be broadcasted regularly. Other radiophone stations are being operated in Portland by W. P. Hawley, Jr., and by the Northwest Radio Manufacturing Co.

New stations at San Francisco have been installed by *The Examiner* and by the Emporium.

Paul F. Johnson, proprietor of The Radio Store at Pasadena, California, has been assigned KGO as the call number for a broadcasting station that he will soon have on the air.

At the present time over one hundred receiving stations scattered throughout rural Missouri are co-operating in the distribution of this market news information.

TOLL BROADCASTING BY A. T. & T. CO.

The American Telephone and Telegraph Co. has erected a wireless telephone broadcasting station on the roof of its 24-story operating building between Walker and Lispenard Streets, New York City. This building is 350 feet high and rises conspicuously above any other building in the immediate neighborhood. The steel towers supporting the antennæ will be 100 feet high. This important radio distributing station is to be equipped with the latest developments of the Bell System, including the use of electrical filters and new methods, whereby, as the business grows, several wavelengths can be sent out simultaneously from the same point, so that the receiving stations may listen at will to any one of the several services. It will be the first radio station for telephone broadcasting which will provide a means of distribution and will handle the distribution of news, music or other program on a commercial basis for such people as contract for this service.

The company will provide no program of its own, but merely the channels through which anyone with whom it makes a contract can send out their own programs. Just as the company leases its long distance wire facilities for the use of newspapers, banks and other concerns, so it will lease its radio telephone facilities and will not provide the matter which is sent out from this station. If there appears a real field for such service and it can be furnished sufficiently free from interference in the ether from other radio services, it will be followed as circumstances warrant by similar stations erected at important centers throughout the United States by the Bell System. As these additional stations are erected, they can be connected by the toll and long distance wires of the Bell System so that from any central point the same news, music or other program can be sent out simultaneously through all these stations by wire and wireless with the greatest possible economy and without interference.

While it is entirely possible, as has been demonstrated by the telephone company, to talk by wireless when all atmospheric conditions are favorable across the continent or even for much greater distances over water, such long distance radio telephone transmission is not dependable and is not to be compared from a standpoint of service or economy with the transmission which is provided over wire. However, for a broadcasting service, which involves only one-way transmission, where the same message is given simultaneously to a great number of people within reasonable distances of the transmitting station, radio telephony offers a promising field for development.

THE WIRELESS COLLEGE

Entering a field of almost limitless possibilities in the realm of education, Tufts College has announced the completion of plans for what is probably destined to be the world's first wireless college. A series of lectures will be given free twice a week, broadcasted by radio telephone to more than 35,000 persons scattered in a great circle whose circumference stretches from Wisconsin to northern Florida.

The broadcasting will be sent out from the Amrad Transmitting Station at Medford Hillside, Mass. In the announcement the instructors and the subjects of their lectures are listed as follows:

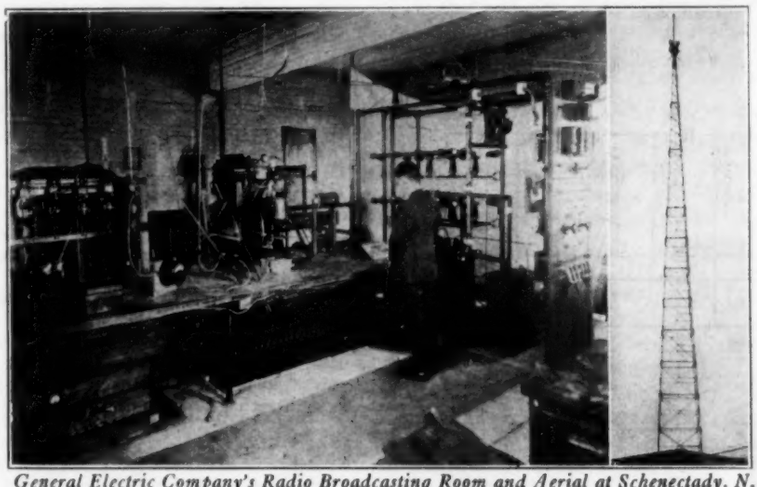
Dean Charles Earnest Fay, A. H., Litt. D. Wade, Professor of Modern Languages and Dean of the Graduate School, will give the opening and introductory address on a date next week to be announced. He will describe the lectures to be given and in general tell of the aims of the course. As a lecturer on literary and geographical subjects, Dean Fay has few equals. He has been a pioneer in the development of mountaineering in the Canadian Rockies and the Selkirks since 1900. Mount Fay in the Selkirks is named after him.

Dr. Harvey A. Wooster, Jackson Professor of Political Science and head of the Department of Economics at Tufts, will deliver the second lecture of the course on "The Story of Money."

Dean Gardner C. Anthony, A. M., Sc D. of the Engineering School, will talk on "The Story of Engineering."

The remaining speakers and the subjects which cover a wide field of human knowledge are: "Changes in Europe," by Dr. Arthur I. Andrews; "Preparedness Among Animals," by Dr. Alfred Church Lane; "The Story of Architecture," by Dr. William F. Wyatt;

Continued on page 72



General Electric Company's Radio Broadcasting Room and Aerial at Schenectady, N. Y. The Tower is 183 ft. High *International Photo*

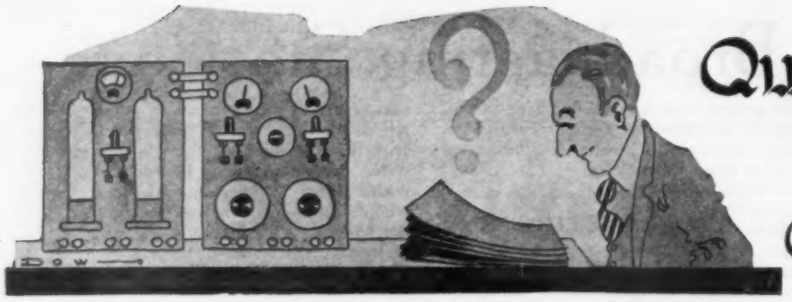
Detroit News Radiophone, Employing Two 250 Watt Tubes as Oscillators, Two as Modulators, and One 50 Watt Tube as Speech Amplifier. This is Western Electric Instrument Used in Clement Test for New York, and Gives Radiation of 7 Watts.

Concert programs are sent out by radio broadcasting station WGY of the General Electric Co. at Schenectady, N. Y., on Tuesday, Thursday and Friday nights at 7:45 o'clock, Eastern time. Every night, except Saturday and Sunday, WGY broadcasts at 7 o'clock market quotations supplied by the New York State Department of Farms and Markets. All broadcasting by this station is on a wavelength of 360 meters.

The concert program which was broadcasted from WGY at 11:30 p.m., Eastern time, Friday, March 24th, for the benefit of the western territory, was heard by a number of Pacific Coast stations, including a verified reception by KZY.

Gould, The Light Man, of Stockton, California, announces that his radio broadcasting station will be employed by the Ministerial Union of Stockton for the purpose of furnishing listeners with Sunday service from station KJQ, between the hours of 10 and 11 a.m. KJQ broadcasts concerts on Wednesday and Sunday evenings from 7 to 8 p.m., and on Wednesday from 5 to 5:30 p.m.

The Missouri State Marketing Bureau market news broadcasting station—WOS—was one of the first stations, if not the first, to urge the usage of the radiophone for state programs for broadcasting market news to farmers. They have given an order to a New York manufacturer for a $10,000 broadcasting and receiving outfit, which has for its object the giving to Missouri farmers reliable government market news throughout the year. The office is on the leased telegraph wire of the U. S. Bureau of Markets, off of which they get market news information on all farm products from practically all of the important markets of the United States.



Queries & Replies on C.W. practice by Gerald M. Best, Technical Advisor.

Questions submitted for answer in this department should be typewritten or in ink, written on one side of the paper. All answers of general interest will be published. Readers are invited to use this service without charge, except that 25 cents per question should be forwarded when personal answer by mail is wanted.

Question: Please publish a diagram showing a receiving set with two stage amplifier, employing resistance or impedance coupling instead of transformers. Would a vern'er variometer improve the operation of this set? L. L. P., Sultana, Calif.

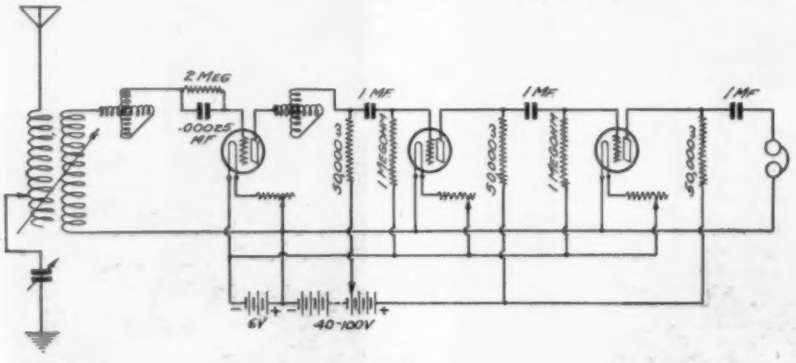


Fig. 1

Answer: The circuit requested is shown in Fig. 1. A vernier variometer would be particularly useful in tuning C. W. signals, in this sort of a receiver.

Question: Kindly give me a wiring diagram of a variometer set, 2 stages of radio fr quency amplification, and detector, all on one panel and connected so that the detector can be used alone, or with one or two amplifiers. A. L., Susanville, Calif.

Answer: The circuit requested is shown in Fig. 2.

Question: Please publish a circuit for a set using honeycombs, series parallel switch, air condensers, detector and two stage amplifier with filament control jacks. L. R., Watsonville, Calif.

Answer: With the exception of the series parallel switch, the circuit you wish was published in March RADIO on page 29. The connections to the switch are shown in Fig. 3.

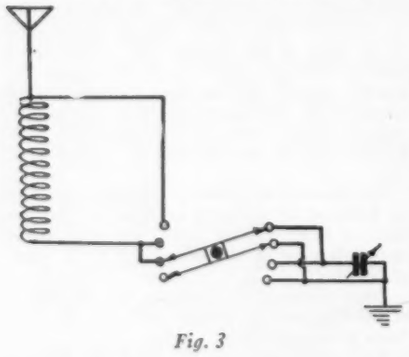


Fig. 3

Question: Can a rectifier tube or any device be used to change 110 volt 25 cycle a.c. to direct current to be used for lighting the filaments of an audion detector and amplifier tube, and how should they be used? H. S., Gilman, Wis.

Answer: Rectified a.c. for the filaments of detector or amplifier tubes is not very satisfactory, and requires the use of an expensive filter which would more than offset anything you might save by not buying a storage battery. A circuit employing a.c. for lighting the filaments of detector tubes is shown on page 52 of February RADIO.

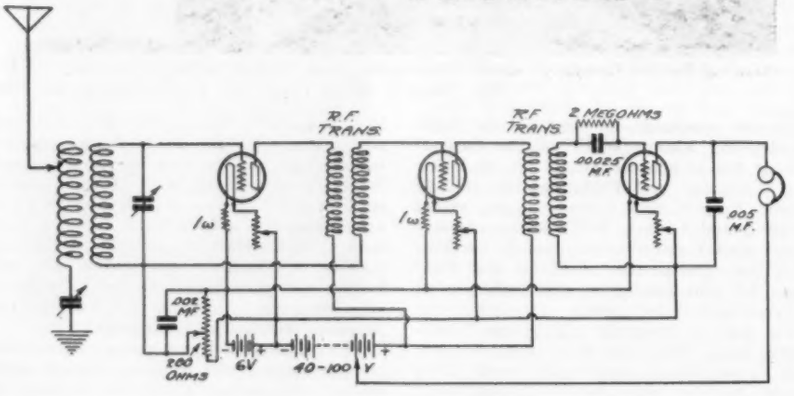


Fig. 2

Question: How do you determine the correct number of jars for rectifying a.c. for the plate of a 5 watt transmitting tube? How is the correct capacity for an antenna series condenser found? M. K., Hermosa Beach, Cal.

Answer: A 5 watt transmitting tube will not require more than 500 volts at the most; hence ten jars will be sufficient to pass that voltage without overheating. As a safe rule, use one jar for every fifty volts input. The capacity of an antenna series condenser depends entirely upon the fundamental wavelength of the antenna, and what wavelength you desire to use for transmitting. An air condenser or variable mica condenser would be the best types, as adjustments can then be made until the proper value has been obtained.

Question: Will a loading coil placed in the primary of the variocoupler of my regenerative set make the set as efficient on higher wavelengths as it is on short waves? P. C. G., Wilkinsburg, Pa.

Answer: No, not unless you can load the secondary at the same time. The most efficient circuit on any wave is one that has all of the turns in both the primary and secondary in close inductive relation to each other.

Question: Which is best for radio frequency amplification: transformer coupled or impedance coupled circuits? R. K., Palo Alto, Calif.

Answer: Both types have their good points. For a transformer coupled circuit, see Fig. 2 on this page. For an impedance coupled or resistance coupled circuit, see the recent articles on the Armstrong Super-Heterodyne, in RADIO.

Question: What is the circuit of the Remler detector panel type 330? Can this set be used with a short wave regenerative receiver? Can a variable condenser be used, and of what capacity? J. H., Menlo Park, Calif.

Answer: The circuit of the Remler No. 330 panel is given in Fig. 4. This panel can be used with any short wave regenerative set. An air condenser, or .0005 microfarads can be used in such a tuner.

Question: Please tell me how to wind the 500 and 1500 turn coils called for in I. A. Weihe's article on page 14 in February RADIO. How can a honeycomb or duolateral coil be tapped? How is the auxiliary tickler of 20 turns wound and placed in primary? B. C., San Francisco.

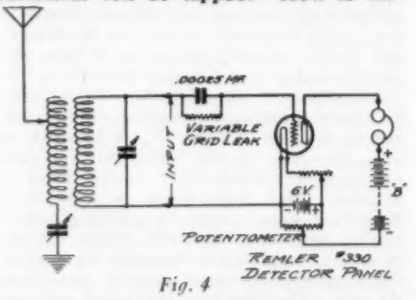


Fig. 4

Answer: Suggest that you look through the back numbers of the current radio publications,

Continued on page 78

C. W. Association of America
Founded by Lawrence Mott

Lawrence Mott, 6XAD, President — *G. G. Griffeth, 6AA, Secretary* — *H. O. de la Montanya, 6AUL, Treasurer*

The C. W. Association of America is devoted to the advancement of the theory and practice of radio communication by means of continuous waves thru the encouragement of experiment and investigation by mutual exchange of experience and assistance. It also provides a medium whereby the government can be assured a reserve personnel thoroughly trained in the radio art should national emergency require. No amateur or professional who is interested in C. W. or any other branch of radio can afford to neglect joining the club, the only organization in the United States devoted exclusively to C. W. interests.

If anyone doubts the superiority of C. W. over other methods of communication, just refer to the recent trans-Atlantic tests of the A. R. R. L., and see the large number of C. W. stations compared with the sparks that got across, and to the log of Clifford J. Dow, 6ZAC, at Wailuku, Hawaii, who is almost daily logging new mainland stations, nine-tenths of which are C. W.

The advice of the club's engineering staff is free to all members. Initiation fee is $2.50; dues, $3.00 per year. In order to start exchange of ideas and experiences with C. W., members are requested to send in a complete, detailed description of their station, including circuits and the apparatus used, together with photographs of station equipment and antenna, if they are available. Descriptions will be published in these columns for discussion only when permission is given to do so. Otherwise comments and advice will be given personally by our engineer. Address all communications to the secretary, room 22, 602 California St., San Francisco, Calif. A list of about ten DX stations worked forming a circle about your station should be included. "Worked" means two-way traffic, not just getting in to the list of calls heard. You are not getting anywhere unless you can "carry-on" with the other fellow.

For our DX test work the following members are ready to arrange a schedule with anyone who will drop them a line. Members who have a regular schedule of hours on the air, please advise the secretary.

6XAD—Lawrence Mott, Avalon, Catalina Island, Calif.
6ZAF—A. H. Babcock, Care Southern Pacific Co., San Francisco, Calif.
4JY—E. Richard Hall, St. Petersburg, Florida.
6JX—G. M. Best, 109 Greenbank Ave., Piedmont, Oakland, Calif.
6AUQ—Ralph Heintz, 653 Miramar Ave., San Francisco, Calif.
6XAQ—L. B. Benjamin, 140 South Oxford St., Los Angeles, Calif.
9ZX, 9EE—H. J. Goddard, Ellendale, North Dakota.
6ZA—Ira J. Kaar, 243 East 7th South, Salt Lake City, Utah.
6ZZ—H. L. Gooding, Box 175, Douglas, Arizona.
9ZY—Ben. A. Ott, Segelhe & Kohlhaus Mfg. Co., La Crosse, Wis.
6WZ—F. S. Wisner, 1906 Chestnut St., Berkeley, Calif.
6ZAC—Clifford J. Dow, Wailuku, Hawaii.
6AUL—R. P. MacKenzie, 1016 4th Ave., Los Angeles, Calif.
6ZE—D. B. McGown, 1247 47th Ave., San Francisco, Calif.

Mr. E. Richard Hall, 4JY, at present the most distant member for the southeast, and a prominent C. W. fan, is building a powerful C. W. set after plans of the C. W. A. A., and hopes to reach the Pacific Coast. He'll do it and we are all anxiously waiting to QSA him. Mr. Hall is president of the Wireless Club of St. Petersburg, Florida, and also City Manager for the A. R. R. L. One of the rules of the Wireless Club of St. Petersburg states: "Any member found to be operating his transmitter on a wavelength over 200 meters shall be fined $5.00 for each offense."

Charles Maass with his two 50 watters will soon be on the ether as air cop for the San Francisco Radio Club. More power to him.

O you VT'S! See the description in another column of that wonderful C. W. set of C. J. Dow, 6ZAC, soon to be on the air at Wailuku, Hawaii, designed for him by our engineers, G. M. Best and Ralph Heintz. Some of these fine nights we may expect to hear Florida and Hawaii discussing the merits of their respective rest camps for the idle rich.

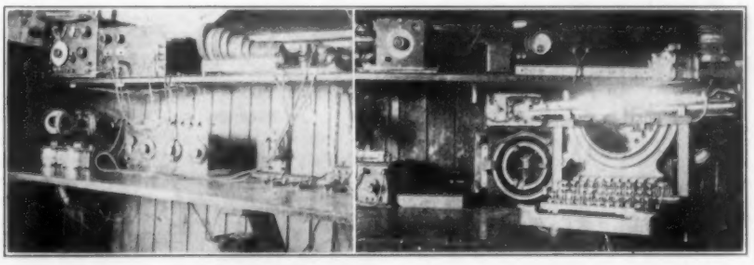
The question has been brought up by a number of Eastern C. W. fans as to whether the C. W. A. A. is a national association or a California association. We wish to say most emphatically that the C. W. Association of America is a national organization of amateurs interested in C. W. It is true that our present officers are located on the Pacific Coast, and mainly in California. This is due, however, to the fact that the C. W. A. A. is a development of the former C. W. Club of California, and that such a large majority of members were located on the Pacific Coast that the officers naturally were selected in this locality.

We sincerely hope that by the next election the membership will be equally distributed over the U. S. and the officers will naturally be chosen from the members available over the U. S. The Eastern membership is pouring in at a rate that bids fair to outnumber the West soon.

Charles Filstead, 6CU, Los Angeles, Calif., is using three 5 watters and radiates 2.4 amps on exactly 200 meters. He has handled considerable traffic, clearing 65 messages in February.

4CB—CANADIAN

Because so frequently reported in calls heard, many readers should be interested in the picture and description of 4CB, operated at Morse, Sask., Canada, by Jack E. Maynard and E. L. Maynard. With 15 watts their C. W. signals have been reported from Chicago, St. Louis, Kansas City, Tucson, Los Angeles, all along the Pacific Coast to Prince Rupert, B. C., and in all the four Western provinces of Canada. They wave worked stations in St. Paul and Minneapolis, Wichita, Kansas, Denver, San Francisco (6AWT), and Portland.



4CB—Canadian

The following data are taken from their card:

My transmitter, 3 UV 202 tubes, 15 W., C. W., I. C. W. and fone, magnetic modulator. Trans. aerial 4 wire

Continued on page 78

DIGEST OF RECENT RADIO PATENTS

Prepared by White, Prost & Evans, Patent Attorneys, San Francisco, who have been particularly active in the radio field for many years, and from whom may be obtained further information regarding any of the patents listed below.

W. Wilson, Pat. No. 1,403,726; Jan. 17, 1922. Electric discharge device and operating circuits therefor.

An audion is described, having in addition to the ordinary three electrodes, a fourth one 9 which is left entirely unconnected, located between the filament 6 and the grid 8. Such an audion may be arranged by choosing the proper negative voltage impressed on grid 8, to have no space current at all; but when the potential of grid 8 is made responsive to the received signals, the space current begins and persists. This space current may be used to operate a relay 35 to ring an annunciator, while at the same time the space current carries the detected signaling current. The relay 35 is then continuously energized until a circuit is broken, for example, the input circuit.

R. W. Wilson, Pat. No. 1,403,932; Jan. 17, 1922. Electron discharge device.

In order to compensate for the contact difference of potential between the grid and filament of an ordinary audion, it has been customary prior to this invention to utilize a battery or other source of constant e.m.f. This, however, does not accurately serve its purpose because each tube may require a different value to neutralize this potential. In this patent the neutralizing potential difference is supplied by the drop across a resistance 6 in the anode circuit. The value of the space current thus determines the value of the neutralizing e.m.f. and in this way the proper regulation is effected to maintain this space current nearly constant.

Brillouin & Beauvais, Pat. No. 1,404,573; Jan. 24, 1922. Telephone installation in wireless telegraphy.

Amplification of high frequency currents is secured by a plurality of thermionic tubes. The plate circuit of each tube includes a resistance d′, d^2 etc., as well as a common plate battery b. The fluctuations of plate potential are impressed on succeeding grids, and in the last plate circuit the telephone g is substituted for the resistance. By the use of condensers f′, f^2 etc., between the plate of one tube and the grid of the succeeding tube, only the high frequency variations are transmitted to the tube. A potentiometer arrangement k-j is used for determining the mean potential of all of the grids.

L. N. Brillouin, Pat. No. 1,404,574; Jan. 24, 1922. Telephone and wireless telegraphy installation.

An arrangement similar to that of the Brillouin and Beauvais patent is described, in which resistances d′, d^2 etc., are connected in the plate circuits, the plate of each tube being connected to the grid of the succeeding tube through a condenser, such as f^2, etc. In order to produce heterodyning or at least increased amplification, the grid 100 of the first tube is in addition connected through a variable condenser 1′ with the plate of one of the succeeding tubes.

E. F. W. Alexanderson, Pat. No. 1,404,726; Jan. 31, 1922. Removing sleet from antennae.

A multiple conductor radiating antenna is described, so constructed that heating current may easily be sent through only a portion of the conductors to remove sleet; furthermore the antenna has substantially the same radiating characteristic as one in which all of the conductors are earthed at several points along the length of the antenna. Such a construction would make it difficult to supply heating currents to a part of the conductors only. However, at each grounding point, such as along the dotted line 35, only a relatively small portion of all of the conductors are earthed at 40, those not earthed being so close to those that are, that there is no loss in radiating power over the arrangement where all of them are earthed.

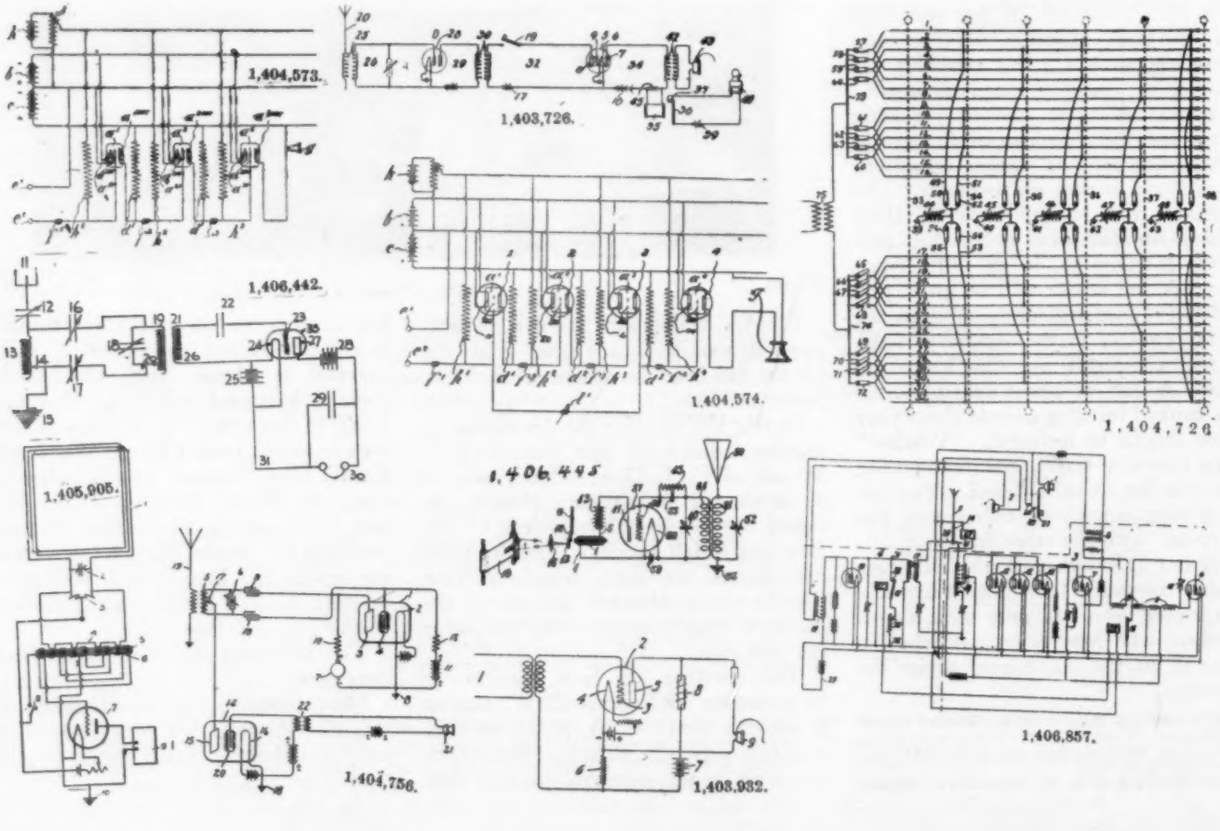
F. W. Dunmore, Pat. No. 1,405,905; Feb. 7, 1922. Radio receiving apparatus.

A closed coil receiving system is described, for direction finding or interference prevention. A clearer minimum point is secured by inserting a transformer 4-5-6 between the detector 7 and the coil 1, this transformer being wound with alternate secondary and primary turns on an iron core.

L. Cohen, Pat. No. 1,406,442; Feb. 14, 1922. Radio receiving system.

High selectivity in receiving is secured by providing an electrostatic coupling between the antenna coil 13, by means of condensers

Continued on page 44



With the U.S. Radio Inspector

Conducted by Major J. F. Dillon

SUMMARIZED REPORT OF DEPARTMENT OF COMMERCE CONFERENCE ON RADIO TELEPHONY

Resolved, That the Conference on Radio Telephony recommend that the radio laws be amended so as to give to the Secretary of Commerce adequate legal authority for the effective control of the establishment of all radio transmitting stations except amateur, experimental and Government stations and of the operation of non-governmental radio transmitting stations. It is the sense of the Conference that radio communication is a public utility and as such should be regulated and controlled by the Federal Government in the public interest. Resolved, That the types of radio apparatus most effective in reducing interference should be made freely available to the public without restriction.

A. It is recommended that waves for radio telephony be allocated in bands according to the class of service, as follows:

Use	Wave Length, Meters	Frequency, Kilocycles per Sec.
(1) Transoceanic radio telephone experiments, non-exclusive	6,000-5,000	50. - 60.
(2) Fixed service radio telephony, non-exclusive	3,300-2,850	90.9-105.2
(3) Mobile service radio telephony, non-exclusive	2,650-2,500	113.2-120.
(4) Government broadcasting, non-exclusive.	2,050-1,850	146.- 162.
(5) Fixed station radio telephony, non-exclusive	1,650-1,550	181.8-193.5
(6) Aircraft radio telephony and telegraphy, exclusive	1,550-1,500	193.5-200.
(7) Government and public broadcasting	1,500-1,050	200. -285.7
(8) Radio beacons, exclusive	1,050- 950	285.7-316.
(9) Aircraft radio telephony and telegraphy, exclusive	950- 850	316. -353.
(10) Radio compass, exclusive	850- 750	353. -400.
(11) Government and public broadcasting, 700 miles inland	750- 700	400. -428.
(12) Mobile radio telephony, non-exclusive	750- 650	400. -462.
(13) Mobile radio telegraphy, exclusive	650- 525	462. -572.
(14) Aircraft radio telephony and telegraphy, exclusive	525- 500	572. -600.
(15) Private and toll broadcasting exclusive.	435- 310	690. -968.
(16) Restricted special amateur radio telegraphy, non-exclusive	310	968.
(17) City and state public safety broadcasting, exclusive	285- 275	1,052-1,091
(18) Technical and training schools (shared with amateur)	275- 200	1,091-1,500
(19) Amateur (exclusive, 150 to 200 meters) (shared with technical and training schools, 200 to 275 meters)	275- 150	1,091-2,000
(20) Reserved	below 150	above 2,000

NOTE 1. The terms used in the above schedule are defined as follows: "BROADCASTING" signifies transmission to an unlimited number of receiving stations without charge at the receiving end. It includes:

(1) *Government broadcasting* signifying broadcasting by departments of the Federal Government.

(2) *Public broadcasting* signifying broadcasting from public institutions, including state governments, political subdivisions thereof, and universities and such others as may be licensed for the purpose of disseminating informational and educational service.

(3) *Private broadcasting* signifying broadcasting by the owner of a station, as a communication company, a store, a newspaper, or such other private or public organization or person as may be licensed for the purpose of disseminating news, entertainment and other service. And

(4) *Toll broadcasting* signifying broadcasting by a public service radio telephone company as a paid service.

B. It is recommended that the Secretary of Commerce assign a specific wavelength to each radio telephone broadcasting station (except Government and amateur stations), this of course being within the band pertaining to the particular service of that station.

C. It is recommended that the wave band assigned to amateurs, 150 to 275 meters, be divided into bands according to the method of transmission, damped wave stations being assigned the band of lowest wavelengths, interrupted or modulated continuous wave radio telegraph stations the next band, radio telephone stations the next band, and finally unmodulated continuous wave radio telegraph stations the band of highest wavelengths. It is recommended that amateurs be permitted to carry on broadcasting within the wavelength band assigned by the Secretary of Commerce to amateur radio telephony.

D. It is recommended that the present regulations governing experimental stations remain in effect.

E. It is recommended that the establishment at any later date of any commercial transmitting stations having more than 1 kw. input to the antenna may, at the discretion of the Secretary of Commerce, be prohibited within 25 land miles of a Government or commercial station or in regions where congestion of radio traffic shall warrant such prohibition.

It is recommended that the Secretary of Commerce assign to each radio telephone broadcasting station a permissible power based on the normal range of the station. Government broadcasting stations, 600 (land) miles. Public broadcasting stations, 250 miles. Private and toll broadcasting stations, 50 miles.

That the same wave (or overlapping wave bands) not be assigned to stations within the following distances from one another, except that these distances may be lowered if the normal ranges of the stations are correspondingly lowered: For Government broadcasting stations, 1,500 miles. For public broadcasting stations, 750 miles. For private and toll broadcasting stations, 150 miles.

That the Secretary of Commerce cause an immediate study to be made of the best geographical distribution of broadcasting stations with the view of attaining the best service with a minimum of interference. A chart has been prepared showing an ideal distribution of broadcasting stations under various assumed conditions as to number of available wave bands and ratio of distance between stations having the same wavelength to normal range of the stations.

That in cases where congestion of radio telephone broadcasting traffic exists, or threatens to exist, the Secretary of Commerce assign suitable hours of operation to existing or proposed private and toll broadcasting stations.

That the degree of public interest attaching to a private or toll broadcasting service be considered in determining its priority in the granting of licenses, in the assignment of waves, and in the assignment of permissible power, within the general regulations for these classes of service.

That direct advertising in radio broadcasting service be not permitted and that indirect advertising be limited to a statement of the call letters of the station and of the name of the concern responsible for the matter broadcasted, subject to such regulations as the Secretary of Commerce may impose.

That the Secretary of Commerce at his discretion prohibit at any time the use of existing radio transmitting apparatus and methods which result in unnecessary interference, provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time interval is allowed for the substitution of the more satisfactory apparatus.

That the Secretary of Commerce at his discretion prohibit at any time the use of existing radio receiving apparatus which causes the radiation of energy.

1. That the status of the amateur be established in the law.

2. That the limits of the wavelength band allocated to the amateur be specified in the law.

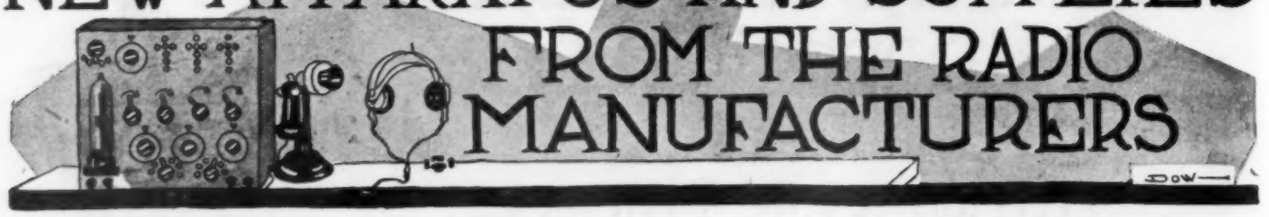
3. That the wavelength band allocated to the amateur be from 150 to 275 meters.

4. That the Secretary of Commerce subdivide the amateur allocation into small or wavelength bands for the various classes of amateur transmitting apparatus, at his discretion, but in the following order of wavelengths, starting at the shortest wave: spark, interrupted or modulated continuous wave telegraphy, telephony, continuous wave telegraphy.

5. That the amateur continue to be under the jurisdiction of the Department of Commerce.

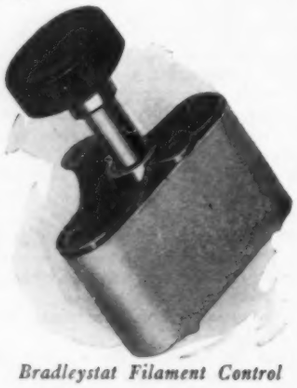
6. It is recommended that for the purpose of self-policing among the amateurs, amateur Deputy Radio Inspectors be created, elected from their number of the amateurs of each locality; that upon receipt of notice of such election the Radio Inspector in charge of the district in which such amateurs are located shall appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year if compensation is legally required; that the duty of such amateur Deputy Inspector shall be to endeavor to the best of his ability to accomplish, under the direction of the District Radio Inspector, observance of the Radio Communication Laws and Regulations of the United States and the observance of such local co-operative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such amateur Deputy Radio Inspectors be clothed with whatever authority may be necessary in the opinion of the District Radio Inspector.

NEW APPARATUS AND SUPPLIES FROM THE RADIO MANUFACTURERS



BRADLEYSTAT FILAMENT CONTROL

For "soft" vacuum tubes the regulation of filament current must be very fine, even to the point of providing for a smooth control of the filament current without any "steps" or "jumps" when varying the current. The ordinary wire-wound coil with a slider contact has limitations because there is a decided change in resistance when the slider moves from one turn of wire to the next. This has been overcome to a degree with the vernier attachments, but the latter usually require either two adjusting knobs or a special operation in one knob that slows up the action and interferes with quick tuning for the best audibility.



Bradleystat Filament Control

The ideal rheostat is one that will give smooth variation in current with a simple one way adjustment. One way to accomplish this is by the use of a compression type rheostat. A rheostat of this nature, especially designed to meet the requirements of ½ and 1 ampere receiving detector and amplifier tubes and 5-watt power tubes, has just been placed on the market by the Allen-Bradley Company, Milwaukee, Wisconsin. It is known as the Bradleystat. A column of specially treated graphite discs, assembled in a porcelain container, form the resistance element in this new device. The resistance of the graphite discs varies with the pressure applied by an adjusting knob and pressure screw. The resistance depends only on the pressure applied to the column of discs and since the pressure can be regulated to any desired degree, the voltage on the filament and the corresponding current can be adjusted to the smallest fraction without any jumps and without any disturbing noises in the head set. There is no sudden change in the current nor no point just a little too high or a little too low. The graphite discs are assembled in two small columns in the porcelain, the pressure screw acting on the disc through a cross piece or equalizer. A small spring lifts this pressure equalizer from the discs when the pressure is relieved so that the circuit is opened and the A battery disconnected when not in use.

Since no two vacuum tubes are likely to be the same in sensibility, owing to variation in the degree of vacuum, the Bradleystat is intended for use with a single tube only. Synchronizing of several tubes is best accomplished with one rheostat for each filament circuit. Owing to the wide range in resistance obtained in a compression type rheostat, a standard Bradleystat can be used universally in receiving tube circuits or in 5-watt power tube circuits, without any change in connections or insertion of different resistance.

The enclosed graphite compression type of rheostat has been made under a patented construction by the Allen-Bradley Company for twenty years and applied to motor starting, battery charging and other current control requirements.

NEW RADIO CATALOGS

Electrose Mfg. Co. have published a broadside sheet illustrating the large line of radio parts and insulators made by them. This also gives dimensions and prices.

Standard Metal Mfg. Co., Newark, N. J., has issued a folder on their radio horns designed to fit all makes of receivers.

Essex Wireless Specialty Co., Newark, N. J., are distributing a folder showing how to use their attachment for attaching a radio receiving set to any make of phonograph and thereby receiving the benefit of the talking machine tone chamber for speech amplification.

Manhattan Electrical Supply Co. of New York City have a new folder on their No. 2500 headset.

Thordarson Electric Mfg. Co., Chicago, Ill., have issued a folder giving valuable information on C. W. transformers for filament and plate supply and on their amplifying transformer for receiving sets.

American Radio and Research Corporation's latest folder, "Wireless Telephone for the Family," attractively describes the Amrad crystal receiving set, which is designed for eventual combination with added vacuum units.

Radio Frequency Amplification is the subject of Bulletin No. 102 from the Radio Service Laboratories, Inc., Asbury Park, N. J. It gives a number of schematic circuit diagrams, with brief explanation, illustrating all desirable combinations of tubes and transformers.

Elwood Electric Co., Inc., is the new corporate name of the former Liddell Electric Mfg. Co., which has been reorganized with Clarence E. Bilton president and treasurer, and C. Edgar Bilton secretary. The plant and office of the company are at 2-4 Randall Ave., Bridgeport, Conn. The company has been manufacturing telephone equipment, binding posts, push buttons and other electrical items for seventeen years and is now producing radio head receivers and other radio apparatus.

RADIO CORPORATION ANNOUNCEMENT

By E. E. BUCHER

The Radio Corporation of America is endeavoring in every way possible to meet the unprecedented demand for radio devices. The factories of the General Electric Company and of the Westinghouse Electric & Manufacturing Company which are manufacturing such devices for the Radio Corporation of America, are now operating on a greatly expanded production program and it is expected that within the next few weeks considerable quantities of material will be shipped on orders already placed with the factories by the Radio Corporation. These will be delivered to customers as rapidly as received in the warehouse.

Distributors are requested to communicate the above information to dealers and to inform them that orders will be filled just as promptly as possible. This applies to all classes of radio apparatus for which we are accepting orders, including Radiotrons, vacuum tubes, etc., which are employed for reception.

We believe that radio broadcasting is here to stay. The great opportunities for the sale of radio devices can, in our judgment, only be properly taken advantage of if all those who are interested in distributing and selling this apparatus, properly equip themselves to handle this class of merchandise in a satisfactory way. This means that the dealer or whoever is effecting the sale to the consumer, must familiarize himself with the product, explain its capabilities as well as its limitations and lend assistance in every way toward the proper installation and maintenance of radio sets.

Those who desire radio equipment and cannot for the moment obtain it, should be informed that the present shortage is but temporary and due entirely to the great demand which suddenly came as a result of broadcasting, and that the Radio Corporation and its associates, the General Electric Company and the Westinghouse Electric & Mfg. Company, are doing everything in their power to produce the necessary apparatus with maximum speed; that normal production is expected to begin within the next few weeks and that deliveries will then be promptly made.

A new catalog covering all of the radio devices being manufactured for the Radio Corporation of America by the General Electric Company and the Westinghouse Electric & Mfg. Company, is now in course of preparation. This catalog will contain information of value to the wholesale distributor, the retail dealer, and the ultimate user of radio apparatus.

ANTENNA WIRE INFORMATION

Radio frequency currents, when conducted by wires at the sending and receiving stations, travel through a thin layer of metal along the exterior of the wires because of the phenomena known as "skin effect." The loss of radio energy in the wires depends on the electrical conducting properties of this exterior layer of metal.

Pure copper is the most efficient commercial metal, insofar as electrical conducting properties are concerned, but lack sufficient strength for a great many purposes. The objection to bronze is because of its poor electrical conductivity—approximately two-fifths as much as copper. Much more radio energy is lost in bronze wire than in copper of equal size.

LET US KNOW
What you want to Know about Radio

Do you want—

	Yes	No
Radiotorial Comment on General Conditions?		
Illustrated descriptions of noteworthy installations?		
Latest news on radio development?		
Design and construction of C. W. transmitters?		
Practical construction of tested equipment?		
Simple explanation of radio phenomena?		
Technical articles with mathematics?		
Imaginative fiction of improbable facts?		
Radio fiction with a kick?		
Radio humor, cartoons and verse?		
Queries and Replies on C. W. Practice?		
Pictures and descriptions of receiving stations?		
Digest of Recent Radio Patents?		
The Radio Inspector's Department?		
List of Calls Heard?		
A study course in the elements of electricity?		
News of the broadcasting stations?		
Who's Who in Radio?		
News from the radio manufacturers?		
News of the radio clubs?		

What other kind of information do you want?_____

_____

_____

_____

_____

Help yourself and your fellow readers by checking the above and mailing it to us. Every reader of "RADIO" is invited to send us the questionnaire.

Special Announcement!

The Next Issue of "RADIO" WILL CONTAIN—

100 PAGES

The June issue of RADIO will be the banner number in the history of the publication. It will contain one hundred pages of the best radio material that has ever been brought to you through the printed page. Future issues will contain one hundred pages or more. Through your co-operation by filling in and sending us the questionnaire that appears on this page we will know just what kind of radio information you are looking for *and we will give you that information.* It makes no difference whether you are a subscriber or buy your copy on the news-stand. Send in the questionnaire in order that the future policy of RADIO may be guided by your action.

The cost of publishing a magazine of one hundred pages is far in excess of the cost of the publication in its present form. Due to the high quality of material that will be published, the extra cost of paper, printing, mailing, etc., the price of single copies will be increased to 25 cents, effective with the June issue. Subscription rates will be increased to $2.50 per year.

You can still subscribe at the $2.00 per year rate—provided that your subscription reaches us by June 30th. We want to give our readers a chance to subscribe at the prevailing rate. News-stand buyers will save one dollar a year on this offer. This is a worth-while saving and it gives you the guarantee of monthly receipt of the magazine. News-stand sales have been unusually heavy of late and many have been unable to secure copies one day after the supply was received by the stands.

Save a dollar!

Take no chance of missing a single issue of the new, big RADIO. Subscribe today at the $2.00 rate. We will start your subscription with the June number, which will be ready for the mails on May 23rd.

Remember that RADIO leads all others in giving you first-hand information. You will find its constructional material to be the best available and nothing misleading appears between the four covers of RADIO. Clip the coupon—drop it in the mail box today.

Do it NOW

COUPON

RADIO,
465 Pacific Bldg.,
San Francisco, Cal.

Herewith is $2.00 for which you will send "RADIO" for one year to:

Name .....

Address .....

.....

BROADCASTING OVER ELECTRIC LIGHT CIRCUITS

By CARL H. BUTMAN

Local radio telephone broadcasting by means of "wired-wireless" on an ordinary electric light circuit was demonstrated in the office of the chief signal officer of the army on Friday, March 24, for the first time before officers of the corps, scientists and representatives of the press.

As the air is left clear for long distance communications, this new development in radio is believed by experts to promise great utility by relieving the congestion in the ether due to the great number of broadcasting stations. By purchasing an ordinary short wave radio receiving set anyone who is fortunate enough to have a direct current electric lighting system in his house, is within reach of entertainment, locally at least.

The demonstration included the receiving of news, music, and talks from a distant room in the Munitions Building, where a radio telephone transmitter (S.C.R. 67) was connected through an ordinary light socket to the lighting circuit of the building. Music from a phonograph was transmitted to the 110 volt d.c. electric line through a standard microphone such as was developed during the war for aviators.

In General Squier's office a standard Westinghouse short wave radio receiver was connected with the lamp socket on his desk, and by pulling the cord, he started and stopped the music. No head pieces and no extra wiring or antenna were used, the sound coming from a loud-speaker near the set on the wall.

With receiving sets of similar type the entertainment could have been heard in any room of the great building, but not outside, as the wire was a private lighting circuit for the building. In a small town, or a large city with a single lighting system, anyone with a receiver could plug in and get the news of the town, the entertainment, etc., sent out by a central station.

All the work necessary to install the apparatus was to bring in the receiving apparatus, connect to ground, hang up the horn, and screw an ordinary plug into the light fixture, much the same as an electrical flat iron or toaster is connected. "Every home or every room in a hotel where there is an electric lamp can now keep in touch with the world," General Squier said. "The main feature about it is the fact that it permits local broadcasting without paying the penalty of broadcasting in space from the usual antenna, which has resulted already in so much confusion," he continued. There is no interference, no fading, and weather does not affect the broadcasting by the new method.

The process is based upon General Squier's invention of "line radio" or "wired-wireless," perfected some time ago, which permits the use of a wire as a guide, but the messages are transmitted on radio waves which follow the wire. The turning of the switch breaks the circuit and the sound ceases.

Future uses for the new invention which the General has made public, suggest that a hotel can supply all its guests with music, from a sending station in the basement, a phonograph salesman can demonstrate his new records to everyone in town by putting them on the light circuit, one orchestra can furnish music for the local playhouses and movies, invalids at home or in hospitals can get the news and such entertainment as is furnished locally, even advertising could be sent out to every citizen in town by agents and stores.

THE NAVY'S NEW RADIO REPAIR SHIP "GOLD STAR"

To supply, repair and keep in touch with its eight radio traffic and two compass stations in Alaska, the Navy Department has just designed and commissioned a special vessel as a radio repair ship. Its name is the *"Gold Star,"* in commemoration of the "Gold Star" mothers of the World War, and she is equipped with all kinds of radio equipment, spare parts and a crew of expert repair men and artificers capable of erecting a large radio station or repairing a small receiving set.

A former Shipping Board vessel of the "B" type, the *Gold Star* has just been remodeled at the Philadelphia yard and equipped for her work which will carry her north in the Pacific nearly to the Arctic Circle. She is an 11 knot vessel of 7420 tons, 377 feet long, and will carry a complement of 300 officers and men, under command of Lt. Commander J. C. Katterfield, who commanded the *Saturn,* an old ship which the *Gold Star* will relieve. On March 18, the *Gold Star* started on her cruise to Hampton Roads, from which port she will leave April 10 for the Pacific Coast.

At present the traffic stations operated by the Navy in Alaska comprise St. George, St. Paul, Dutch Harbor, Kodiak, Seward, Cordova, Juneau and Ketchikan, but compass stations are also maintained at Cape Hinchinbrook and Soapstone Point. During the war these stations intercepted enemy messages, communicated with our forces, and formed part of the chain of communication in Alaska and adjacent waters. The Transpacific circuit via Cordova and St. Paul formed an important line of naval communication service during the recent Arms Conference, and aided in the furtherance of governmental and commercial interests in Alaska, besides serving as a relief in the event of a break in the army cable.

As these stations are most difficult to reach, but few commercial vessels touch there, especially from October to April, and because of the need for supplies and frequent change in personnel, the Navy has decided to have its own radio station tender and repair ship. The failure of radio equipment and material must be replaced immediately and kept in condition for constant use through the long winter months, necessitating frequent trips of a supply ship. Having tried commercial means of transportation with unsatisfactory results and with great expense the Navy has now assigned a ship to this special duty to succeed the old *Saturn,* built in 1898 and listed as a fleet tender.

The radio garter is an invention of Walter P. Miller of the Seattle Post-Intelligencer, whereby the girl reporter can listen in to the radiophone broadcasting at any time. With an aerial concealed in her hat, a "ground" attached to her shoe and a receiver hooked on her hat over her ear milady need never be at a loss for radio entertainment. This crystal set is made by winding wire on a piece of stiff cardboard covered with silk to give the appearance of a garter. Attached to this are two ordinary eyeglass snap chains, one of which held under the foot makes a ground for the current, the other fastened to the coil of wire arranged in the hat forms the aerial. A small bottle with the crystal in it and a telephone receiver complete the novel invention.

NEW YORK RADIO SHOW

As a spectacular exhibit of public interest in radio, the show held in the Hotel Pennsylvania, New York City, during the week ending March 11th, was a success. It is estimated that 38,000 people attended the show and thousands more were unable to gain admittance.

Public interest centered on a miniature torpedo whose movements were controlled by radio, this being exhibited by E. F. Glavin. Another attraction was the Lyraudion concert grande, which poured forth from its husky throat an appalling volume of sound amplified from the feeble, music-laden currents received from the broadcasting stations.

The fifty exhibitors showed radio receiving equipment of all kinds from the tiniest of crystal receivers to the elaborately housed and finished tube sets. The new "batteryless," "grid-leakless" vacuum tubes excited great interest, as did also a small attachment enabling any phonograph to be used instead of the usual type of loud speaking horn.

The Signal Corps of the U. S. Army had an exhibit which attracted many visitors. Various loud speaking devices were much in evidence, but in the words of one observer, "if the show proved one thing, it certainly proved the need for better instruments of this sort."

A number of lectures were given during the show, including a paper on "Vacuum Tubes and Their Operation," by W. C. White of the General Electric Co., and on account of the A. A. R. L. Trans-atlantic test by Paul F. Godley. A very unique and remarkably enlightening moving picture produced at great expense by the Western Electric Company made plain to all who saw it just exactly "what happens in a vacuum tube."

The show was held under the direction of the Executive Radio Council, Second District, made up of two delegates from each of the clubs in and around New York, being the second annual convention and exhibit of the Council. A radio ball and banquet was a part of the program.

Radio waves are merely a very long form of light waves. The difference in length of radio waves corresponds to the difference in color of light rays. But whereas light waves vary from about one-two-millionth of an inch for violet up to one-millionth of an inch in length for red, the other colors of the rainbow each being of an intermediate length, radio waves vary from 200 meters or less in length for the amateur station up to 30,000 meters for the long-distance commercial or government stations. The observer's eye might be said to be "tuned" to green light if he wore a pair of spectacles allowing only green light to pass, much as a receiving aerial is "tuned" to 360 meter radio waves.

Communication with moving trains has been successfully demonstrated in France. From a compartment equipped with radio transmitting and receiving equipment radio telephone conversation has been maintained with a fixed station 34 miles distant.

Roswell, N. Mex., April 5, 1922.

Editor RADIO—Dear Sir:

On March 28 the Pecos Valley Radio Society was organized with eleven radio fans present. Mr. Louis Falconi was elected president of the society. (Mr. Falconi is owner and operator of 5ZA.) L. F. Woodhead was elected treasurer, C. L. Sanders elected secretary. Arden Boellner and Capt. C. A. Flannery were elected to serve on the executive committee with the president, secretary and treasurer. L. B. Merchant appointed publicity committee.

The society meets the second and fourth Tuesdays in every month, and has made application for affiliation with the A. R. R. L. and hopes to be affiliated with other radio clubs, etc.

Code practice will be a feature during the summer when static prevents ether activities, and by fall we hope to have a number of stations capable of doing good work.

In one week we have taken in fifteen new members and from the interest shown we will have a goodly number and we are endeavoring to be the pioneers in this territory.

Yours very truly for the advancement of radio,

PECOS VALLEY RADIO SOCIETY,
Box 16, Roswell, N. M.
C. L. SANDERS, Sec.,

Readers are invited to send in lists of calls heard from stations distant 250 miles or more from their own station.

BY KENNETH PATON, CASHMERE, WASHINGTON

6abw, 6qr, 6cv, 6zx, 6abx, 6zr, 6atj, 6qt, 6xm, 6jd, 6qg, 6amk, 6aru, 6arf, 6aid, 6di, 6agf, 6aix, 6re, 6ix, 6aji, 6sj, 6agr, 6atq, 6ird, 7bk, 7zm, 7kj, 7ck, 7mu, 7cs, 7hf, 7bj, 7zt, 7ya, 7ys, 7cd, 7zu, 7gt, 7yg, 7yl, 7nn, 7bc, 7zu, 7tj, 7mp, 7ly, 7bh, 7mf, 7bx, 7vo, 7zk, 7zj, 7jd, 7cn, 7id, 7iw, 7rt, 7bj, 7xc, 7nz, 7wg, 7hm, 7zv, 7nw, 7cu, 7vz, 7by, 7ot, 7hw, 7it, 7zp, cl8.

Canadian—9ax, 9bd.

C. W., phone and I. C. W.—6xad, 6xg, 6afi, 6aat, 6aif, 6xaf, 6aru, 6atq, 7aag, 7ma, 7ys, 7xf, 7yn, 7cf, 7nf, 7ln, cl8, 9dth, 9aua, 9wd, 9dtm, 9db, 9awp, 9zaf, 9zl, 9bbf, 9pd, 9wu, 9bji, 9zcl, cv5, klp, kfc, kwg, kvq, kdn.

BY A. E. WOOD, WATSONVILLE, CALIF., BETWEEN JAN. 1 AND FEB. 1, ON A ONE WIRE AERIAL, ONE BULB, AND HONEYCOMBS

Spark—5if, 6ar, 6ak, 6ag, 6cp, 6ea, 6ec, 6lr, 6od, 6oh, 6pq, 6pr, 6qr, 6qx, 6aj, 6zb, 6zr, 6zx, 6aah, 6aau, 6abm, 6acr, 6adm, 6adv, 6aix, 6agf, 6ald, 6amk, 6amn, 6akl, 6asf, 6atg, 6aws, 6bak, 6bar, 6xaf, 7bj, 7kk, 7mf, 7ot, 7qr, 9nr.

C. W.—6cf, 6en, 6zq, 6za, 6aif, 6xac, 6xg, 6wv, 6xw, kzm, kzy, kwz, jjj (Radio Shop), 6xak, 7xf, 9nx, 9zl, 9bd, 9bj, 9dva.

AT 6AMZ, SAN MATEO, CAL.

Spark—5hk, 6cf, 6da, 6ea, 6eb, 6eh, 6en, 6fh, 6fk, 6gf, 6gk, 6gt, 6gx, 6ii, 6is, 6iv, 6jl, 6jy, 6ka, 6kc, 6km, 6ks, 6lc, 6mh, 6od, 6ol, 6ot, 6st, 6tf, 6to, 6wc, 6wg, 6zr, 6zz, 6zal, 6zam, 6aah, 6aak, 6aau, 6abm, 6abw, 6abx, 6acr, 6acy, 6adl, 6aei, 6afn, 6agf, 6agp, 6ahp, 6ahq, 6aib, 6aif, 6aio, 6aix, 6aiy, 6ajh, 6ajr, 6akl, 6ald, 6alp, 6alr, 6alu, 6amn, 6aoe, 6aoz, 6ark, 6ath, 6atz, 6auc, 6avr, 6awh, 6bcj, 6bgu, 6biu, 7bc, 7bh, 7bj, 7bk, 7cn, 7cp, 7fi, 7gt, 7hf, 7in, 7jd, 7jw, 7kb, 7jk, 7mf, 7mp, 7myk, 7nf, 7nn, 7nz, 7tj, 7to, 7wg, 7zj, 7zm, 7zn, 7zp, 7zt, 7zu, 7zv, 7yg, 7ya, 7yj, 7yl, 7ys, 8yn, 9yae-Can., 9ax, 9bd, cl8.

C. W.—Can. 4cb, 9bd, 5fv, 5za, 6cu, 6en, 6gd, 6jd, 6jj, 6ka, 6rr, 6wv, 6xd, 6xad, 6xaq, 6aat, 6aif, 6alu, 6atg, 6za, 6zb, 6zf, 6zz, 6zad, 6asv, 6bir, 7ln, 7nn, 7qt, 8box, 9kp, 9nx, 9wd, 9wu, 9amb, 9dva, 9zaf, cl3, cl8.

Heard on one tube and short wave set; January and February. Anyone hearing 6amz C. W., pse qsl.

AT 7KP, SEATTLE, ONE TUBE

Spark—5hk, 6agf, 6ain, 6aix, 6ajh, 6ajr, 6amk, 6ark, 6avr, 6bip, 6bm, 6cp, 6dm, 6ex, 6fh, 6gr, 6km, 6le, 6mh, 6qr, 6to, 6tu, 6vw, 6vx, 6wm, 6zam, 6zx, 7abp, 7cn, 7ed, 7mp, 7tj, 7vz, 7zt, 7zu; Can. 9bd.

C. W.—2fp, 4bq, 5fe, 5qa, 5za, 6aat, 6aau, 6aif, 6alu, 6awt, 6dr, 6en, 6gy, 6hc, 6ka, 6ky, 6rr, 6xad, 6za, 6zad, 6zf, 6zs, 7aav, 7hw, 7ln, 7nf, 7ot, 7tq, 7we, 8agz, 8bk, 8xv, 9ays, 9bsg, 9kp, 9ps, 9wd, 9zac, bf2, cl8; Can. 4bt, 4cb, 5bi, 9bd.

BY 7TT, PORTLAND, OREGON

Canadian—4cb(cw), 9ax. Spark—6ex, 6hc, 6km, 6lc, 6pj, 6qr, 6tu, 6tv, 6vx, 6aad, 6abx, 6agf, 6aix, 6ark, 6zk, 6zm, 6zr, 6zx, 6zaj, 6zam, 7bh, 7ce, 7dg, 7go, 7hh, 7iu, 7ku, 7jd, 7mp, 7nn, 7ot, 7qi, 7rg, 7wt, 7xa, 7xd, 7ya, 7vh, 7yj, 7zm.

C. W.—5za, 6ad, 6gy, 6jj, 6aat, 6aif, 6xad, 6zaf, 7ad, 7ux, 9amb, 9zaf.

BY 9EA, DULUTH, MINNESOTA

C. W.—9aqr, 3bec, 3fs, 4bq, 4ft, 5uu, 8agz, (8aim), 8ajv, 8aqf, 8axk, 8bcx, 8bk, 8box, 8bxh, 8caz, 8ea, (8iv), 8jl, 8js, 8ju, 8ni, 8vy, 9ark, 9aja, (9ajp), 9akb, (9akr), 9als, 9anf, 9as, 9aua, 9awm, 9ayh, 9ays, 9bca, 9bbf, 9bcd, 9bi, 9bji, 9bjv, 9bsg, 9dfg, 9dv, 9dyn, 9fm, 9hk, 9io, 9kp, 9nx, 9ps, (9qe), 9sj, 9wk, 9xaq, 9xi, 9zac, 9ze, 9zl.

Spark—5hk, 8axy, 8eb, 8xh, 9aaw, 9aeg, (9aig), 9aka, 9ama, 9aou, 9arx, 9asn, 9avz, 9axu, 9ayn, 9ayw, 9da, 9dfx, 9ks, 9dpb, 9hi, 9hm, 9hr, 9jaa, 9jn, 9lw, 9mc, 9nr, 9sm, 9st, 9zc, 9zx.

CALLS HEARD

BY 3GG (CANADIAN), M. J. CAVENEY, TIMMINS, NORTHERN ONTARIO, CANADA

1awb, 1ary, 1ayw, 1bdi, 1bus, 1bwy, 1io, 1mx, 1ts, 1xm, 2aab, 2bak, 2bej, 2btj, 2bfx, 2cbg, 2fp, 2ql, 2ts, 2va, 4id, 4ft, 5uu, 5fv, 8asb, 8aim, 8awy, 8axk, 8aqh, 8apt, 8alv, 8auo, 8aiz, 8bu, 8bfx, 8bbk, 8bel, 8buq, 8bzy, 8bdo, 8box, 8bk, 8cp, 8cbr, 8cgm, 8ea, 8fa, 8hj, 8kp, 8nl, 8px, 8rh, 8sp, 8tk, 8uk, 8uc, 8vy, 8yv, 8zg, 9aiv, 9af, 9akf, 9agr, 9ajb, 9aav, 9atm, 9ay, 9bed, 9bjv, 9dbq, 9dfx, 9dv, 9dzq, 9dnt, 9dzy, 9dwp, 9dkv, 9dxt, 9ea, 9gk, 9io, 9iv, 9kp, 9lw, 9le, 9ol, 9qe, 9tv, 9ul, 9vl, 9wk, 9yq, 9yak, 9yo, 9yb, 9yc,
Phones—kdka, kyw, wjz, wdy, nsf, 2xj.

BY 6CU, CHARLES F. FILSTEAD, 2010 6TH AVE., LOS ANGELES, CALIF.

Spark—5mj, 5xd, 5xu, 6aah, 6aau, 6abh, 6abw, 6abx, 6acl, 6acr, 6ada, 6aeb, 6afn, 6afp, 6afr, 6ag, (6agf), 6agk, 6ah, (6ahf), 6ain, 6ajf, 6ajh, 6ajr, 6alv, 6amk, 6ang, 6anh, 6aor, 6app, 6ark, 6as, 6ask, 6asv, 6ath, 6atq, 6auc, 6aud, 6avb, 6awx, 6bca, 6ben, 6bft, 6bhq, 6biu, (6cp), 6ex, 6fh, 6gr, 6gt, 6gx, (6hc), 6km, 6mz, 6ng, 6oh, 6ot, 6po, 6pr, 6qk, 6qr, 6sj, 6to, 6tu, 6tv, 6uo, 6vk, 6vx, 6vz, 6wz, 6zam, 6zb, 6zk, 6zu, (6zx), 6zz, 7bh, 7bj, 7bk, 7ck, 7hf, 7in, 7jd, 7ly, 7mf, 7mp, 7oh, 7ot, 7tj, 7vo, 7ya, 7yg, 7yj, 7za, 7zj, 7zm, 7zq, 7zt, 7zu, 7zv, 9dsd, cl8.

C. W.—4ft 5ak, 5za, (6aat), 6ak, 6ale, 6aoz, (6asj), (6asv), (6awt), 6awv, (6gy), (6hc), 6jj, 6lr, (6oo), (6pt), 6to, 6vm, 6xaf, 6xh, 6za, (6zb), 6zf, (6zz), 7nf, 7qt, 7tq, 7we, 7xf, 8agz, 8xv, 8zp, 9aja, 9amb, 9ays, 9bji, 9db, 9dth, 9dtm, 9dva, 9ji, 9nx, 9ps, 9wd, 9wu, 9xaq, 9zac, (9zaf), kzy, nof, cl8, Can. 9bd.

These stations were worked on three 5 watt tubes radiating 2.4 on exactly 200 meters. Jan. 28th when radiating .8 amp. on one 5 watter was heard by 9aig, Sioux Falls, S. D., on detector alone. Distance is 1330 miles. Cards will be appreciated and promptly answered.

HEARD AT 7CV, VANCOUVER, WASH., S. HOBERT, 815 COLUMBIA ST.

Spark—Can. 5ak, 9ax, 9bd, 5za, 6cp, 6ec, 6ex, 6gi, 6gr, 6hc, 6ol, 6tu, 6vx, 6zu, 6aav, 6aei, 6agf, 6ajh, 6ajr, 6amf, 6amk, 6aph, 6ark, 6atu, 6avd, 6zam, 6awi, 7at, 7bc, 7ej, 7ju, 7ly, 7mp, 7mu, 7nw, 7om, 7ot, 7ub, 7ut, 7vx, 7vz, 7wm, 7ya, 7zu, 7aad.

C. W.—Can. 4cb, 6en, 6gy, 6ka, 6rr, 6zf, 6afi, 6aif, 6alu, 6bcd, 6xad, 7il, 7rn, 9wu.

HEARD BY 6EA, H. C. SEEFRED, 343 SOUTH FREMONT AVE., LOS ANGELES, CAL.

C. W and I. C. W.—2fp, 5za, (6ak) (voice), (6ax), (6gy), (6jx), 6nx, 6pk, 6vm, 6aat, 6arb, (6asx) (buzzer and voice), 6aul, 6awt, 6bcd, 6za, 6ze, 6zx, 6zz, 6xaf, 6zad, 6zaf, 7dp, (7ln), (7xf) (chopper and voice), (7xg) (chopper and voice), 8xv, 9amb, 9bji, 9dtm, (9dva), 9wd, 9xm, (9zaf) (voice), cl8, wv6 (voice). Best 5 watt I. C. W. "QSO" was with 7xg and 9dva (850 miles).

Spark—5xd, (5xu), 5za, (6ah), (6ak), (6as), 6cp, (6ex), 6fh, (6gf), (6gr), 6gx, 6hc, 6ib, 6ic, 6im, 6km, (6lu), 6oc, 6oh, 6pj, (6pr), (6qr), (6qs), 6st, 6tu, (6tv, Ariz.), 6vk, (6vx), 6wg, 6wz, 6aaa, 6aau, 6abk, 6abw, 6abx, 6acr, 6aei, 6afd, 6afp, (6agf), 6ain, 6ajf, 6ajr, 6ala, (6alv), 6amk, 6ang, 6aor, (6ark), (6avb), 6xh, 6zd, 6ze, 6zk, (6zx), (6zz), (6zam), 7bk, 7gj, 7iw, 7jd, 7jw, 7kb, 7mf, (7tj), 7ya, 7yg, 7zj, 7zm, 7zp, 7zt, 7zu, (cl8). Best spark "QSO" was with 5xu (1,230 miles). Best spark reported heard was by Mr. W. D. Van Dyke at Chattanooga, Tenn. (1,915 miles).

BY 6AHR, 659 CLAYTON ST., SAN FRANCISCO, CALIF., ON ONE TUBE

6cj, 6cu, 6cw, 6da, 6eb, 6gt, 6hy, 6jy, 6kc, 6kp, 6nl, 6ol, 6uw, 6zu, 6zz, 6aak, 6aau, 6aic, 6aif, 6aio, 6aiv, 6ajh, 6ale, 6alu, 6ame, 6ano, 6ape, 6asr, 6asv, 6aud, 6aug, 7in, 7yg, 7zt. Would like to hear from anyone who has heard my C. W.

BY 6EB, L. F. SEEFRED, 343 SO FREMONT AVE., LOS ANGELES, CALIF.

C. W.—4bq, 5za, 6gy, 6jq, 6km, 6nx, 6za, 6zf, 6zx, 6zz, 6aat, (6asx, voice and buzzer), 6awt, (6bcd), 6xaf, 6zad, 6zaf, 7dp, 7nf, 7xf, 8xv, 9ayu, 9bex, 9dth, 9nx, 9wd, 9zac, 9zaf voice also, wv6 music.

Spark—5xd, 5xu, 6aaa, 6aah, 6aau, 6abm, 6abw, 6abx, 6aei, 6afn, 6afy, (6agf), 6ain, 6ajr, 6ala, 6alv, 6amk, 6ark, 6aou, 6ape, 6bak, 6bip, 6zae, 6as, 6bb, 6co, 6cp, (6ex), 6fh, 6gf, (6gr), 6gx, 6hc, 6hp, 6ib, (6ic), 6ik, 6km, 6oc, 6op, 6po, 6qr, (6rs Ariz. now), 6tu, 6tv Ariz. now., 6vk, 6vx, 6wg, 6wz, (6xh), (6zi), 6ze, 6zk, 6zx, 7gj, 7iw, 7jd, 7kb, 7ot, (7tj), 7to, 7ya, 7zj, 7zm, 7zp, 7zt, 7zu.

My 5 watt I. C. W. using 550 v. on anode was reported heard by 9bd, Vancouver, B. C., approximately 1200 miles.

Radio brings it MAGNAVOX tells it

The Magnavox Radio, constructed on the *electro-dynamic* principle (with movable coil)—the most sensitive and also powerful converter of electrical energy into sound waves.

TO enjoy the fullest possible service and value from your receiving set, equip it with a Magnavox Radio—the *scientifically correct* reproducer. Comparative tests by experts and amateurs alike have established Magnavox Radio as the world's standard loud-speaker.

Concert and dance music, speeches, songs—Magnavox Radio amplifies them all in volume and marvelous clarity, multiplying many times the use you now get from your wireless. The hookup is simple, and no extras or adjustments are required.

No wireless receiving set is complete without the Magnavox Radio. Any dealer will demonstrate for you, or write us for descriptive booklet and name of nearest dealer.

THE MAGNAVOX COMPANY
Oakland, California
New York Office: 370 Seventh Avenue, Penn Terminal Bldg.

The Magnavox Power Amplifiers insure getting the largest possible power input for your Magnavox Radio. Can be used with any "B" battery voltage up to 1,000.
2 and 3 stage

MAGNAVOX Radio

CALLS HEARD

8AGZ, EAST CLEVELAND, OHIO

Has been in operation since Jan. 11, 1922, and has been reported by the following:

6aoi, 6rr, 6aif, 6atg, 6abw, 6alp, 6agh, 6aqp, 7kp, 6xaq, 6xad, 6iv, 6ajr, 6agf, 6ak, 6cu, 6arf, 7yj, 6awp, 6zz, 6ky, 6en, 6oh, 6aj, 6are, 6hy, 7mp, 6bcr, 6awt, 6aju, 6ka, 6gy, 6ame, 6atf, 6lc, 7zu, 9bd and 5cn, Vancouver, British Columbia; Mr. Riople, Hollywood, California; Mr. Bridges, Loleta, California; U. S. S. Kanawha; Mr. Wheatstone, Long Beach, California.

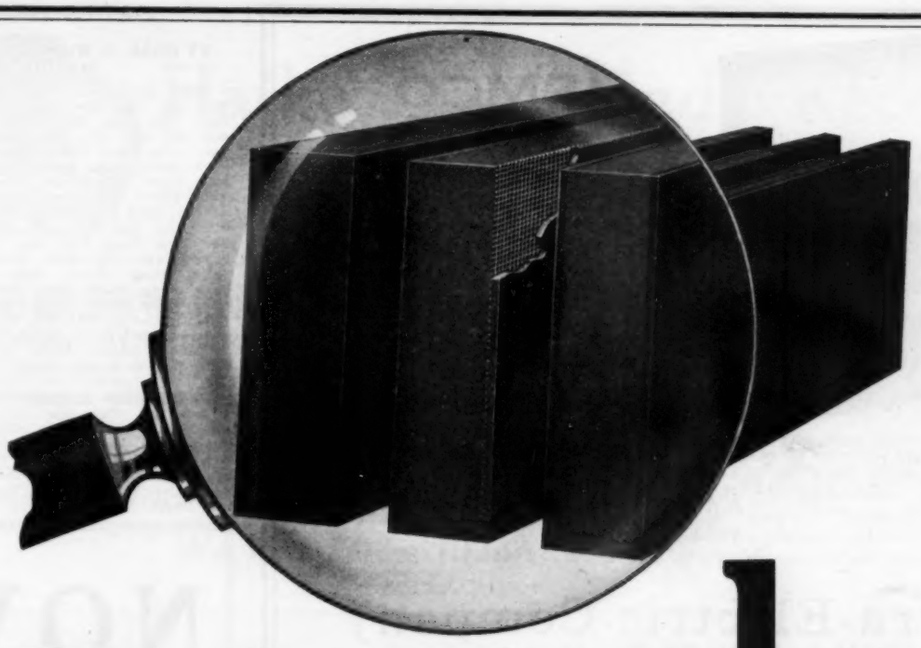
The record made by this radio 'fone set is about 1000 miles, made in tests to several stations such as 9nx, 9ps, 9nk, 4il, and 4co.

One thousand volts direct current generator and rectified a.c. for plates. Hartley oscillation circuit, radiation 6 amperes. Radio 'fone uses Heising modulation 2 50-watt oscillators and 4 5-watt modulator tubes. Radio 'fone radiation is three amperes. The antenna is of four wires on 16 foot spreader, T type 60 foot lead-in, and is located on top of a concrete building 50 feet high. Two steel towers on this building support the antenna approximately 100 feet above the ground.

The following Pacific Coast stations have been logged at this station:

6awp, 6zg, 6awt, 6xaq, 6aj, 6xad, 6ka, (6zz).

The latter station is very consistent here and often worked; on a one step 6zz can often be copied 15 feet from Baldwin 'fones. Henceforth, station 8agz will be known at 8yd on 375 meters.



Panels

Three distinct and exclusive types

CHOOSE the panel best suited to your needs and made to your own individual specifications. Any size or shape you desire—any quantities, one or a thousand—engraved or plain—polished or dull mat surface—plain blank or fully machined and ready for mounting. Diamond F Radio Panel Service gives you the choice of three distinct types of panels, each a leader in its field.

CONDENSITE CELORON

Grade 10 is the highest type radio insulation made. Extremely high in surface and volume resistivity, high in dielectric strength and low in dielectric losses. It is handsome in appearance, extremely water resistant, machines easily, engraves with clean cut characters, and will give long lasting, satisfactory service.

VULCANIZED FIBRE VENEER

(patent applied for) is made of a hard grey fibre core veneered on both sides with a phenolic condensation product. It meets the demand for quality plus low cost. We recommend it for use in receiving sets and other apparatus where very high voltages at radio frequencies are not involved. It has a smooth jet black surface, machines readily and engraves nicely.

CELORON SHIELDED PLATES

(patent applied for) are made with a concealed copper wire mesh imbedded directly under the back surface of the plate. This wire shield, when properly grounded, very effectively neutralizes all detuning effect and "howl" caused by body capacities. Made in both Condensite Celoron Grade 10 and in Celoron Fibre Veneer.

Send for our Radio Panel Guide

Write today for our special "Radio Panel Guide," giving complete details regarding all Celoron Radio Panels. This guide quotes prices and enables you to determine just how much any type of Celoron panel will cost in either standard or special size—plain or fully machined, and engraved to your own specifications. Don't fail to get your copy of this important Guide by return mail. Write us immediately.

Dealers: Our Radio Panel Service enables you to sell panels completely machined and finished to the buyer's specifications. Write for our Special Dealers Proposition.

DIAMOND STATE FIBRE COMPANY
BRIDGEPORT (near Philadelphia) PENNA.
Branch Factory and Warehouse, CHICAGO
Offices in Principal Cities
In Canada: Diamond State Fibre Co. of Canada, Ltd. Toronto

CALLS HEARD

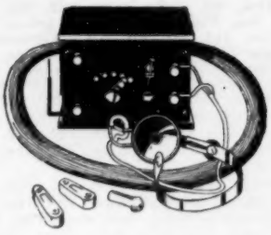
BY CHAS. C. WHYSALL, 8CMI (EX 6TV), MARION, OHIO

1bqa, 1xad fone, 2aje, 2aqi, 2bm, 2bml, 2el, 2fp, 2jz, 2kg, 2oo, 2sz, 2wb, 2xj, 3aev, 3ajd, 3agt, 3ge, 3gm, 3gn, 3hj, 3qw, 3zo, 4bi, 4bq, 4cx, 4gl, 4gn, 5fv, 5hk, 5jd, 5kc, 5rz, 5xa, 5xb, 5xu, 5ye, 5za, 8awu, 8aoe, 8ajx, 8aiq, 8aet, 8aqz, 8avo, 8ars, 8amq, 8ahe, 8axn, 8afd, 8ax, 8ait, 8alo, 8atu, 8aje, 8bco, 9bbu, 8bas, 8bib, 8bis, 8bxx 8bk, 8bun, 8bep, 8bow, 8bfh 8brl, (8cbe), 8cld, 8cmf, 8ew, 8ft, 8iu, 8jm, 8jj, 8kg, 8lb, 8no, 8qe, 8rq, 8tl, 8wz, 8wu, 8wc, 8wo, 8xe, 8yu, 8zaa, 8zo, 8zn, 8zp, 8zz, 9aja, 9arp, 9ayw, 9aas, 9ap, 9arr, 9acn, 9ava, 9aou, 9aeg, 9abv, 9aqm, 9aaw, 9asj, 9awz, 9aul, 9amq, 9aza, 9anp, 9acb, 9aig, 9aua, 9bhd, 9bk, 9dqq, 9deu, 9dev, 9ddz, 9dyy, 9dzy, 9dsd, 9dxk, 9dso, 9del, 9gx, 9hr, 9hi, 9lf, 9lz, 9ox, 9pf, 9qe, 9tv, 9vl, 9wi, 9xt, 9yae, 9yak, 9yq, 9zj, 9zl.

Fone stations—kdka, kzh, kyw, wbl, whk, wwj, wlw, wjz, wgy, wha, wfo.

BY RULON BIDDULPH, PROVO, UTAH

5xd, 5zj, 6bk, 6ea, 6es, 6eu, 6gi, 6gp, 6hy, 6kc, 6nq, 6nx, 6ol, 6qr, 6tu, 6xh, 6za, 6zd, 6zz, 6aag, 6aah, 6aak, 6aei, 6aid, 6aru, 6ath, 6atq, 6awh, 6awt, 6bdg, 6bhg, 6bii, 6xad, 7ad, 7ex, 7fg, 7hm, 7jd, 7ln, 7mp, 7mv, 7nz, 7ot, 7qn, 7tz, 7aav, 7ya, 7yl, 7zm, 7zo, 7ap, 7zu, 7zv, 9nr, 9ps, 9za, 9amb, 9zaf, dd5.



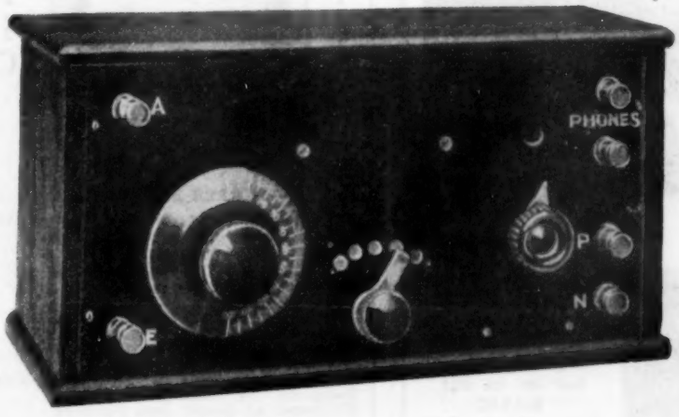
Harko Junior Radio Receiver

$15.00

The HARKO JUNIOR receiving set is the most efficient Crystal Detector set on the market today. Results from using this instrument at our Minneapolis station show that we can "pick up" radio phone concerts, weather reports and news within a radius of from 25 to 50 miles. Telegraph messages have been picked up 300 miles distant without any effort.

Comes complete with phones, insulators and wire sufficient to rig an antenna, together with complete instructions as to installation and operation. Price $15.00.

We Can Make Immediate Delivery



Harko Senior V. T. Radio Receiver

$39.00

Complete with tube, phones and aerial material, but without batteries.

A Combination tuner and audion detector. Operates up to and including 600 meters.

A Real V. T. Receiving Set at an Extremely Low Price of $39.00

Concerts, weather reports, market reports and news of all kinds received from our Minneapolis (Minnesota) station by means of this instrument from Detroit; Cleveland and Pittsburg. Ships and stations on the Atlantic coast have been heard.

WE CAN MAKE IMMEDIATE DELIVERIES

All sets shipped same day order received. *Dealers write or wire for discounts.*

The United Radio Schools

Radio Engineers

700 1st Nat. Bank-Soo Line Bldg. **Minneapolis, Minnesota**

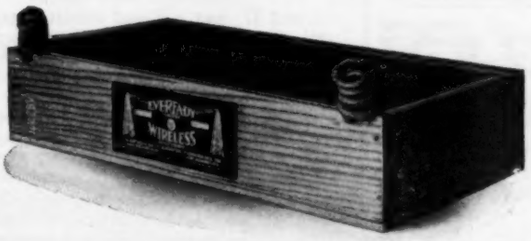
Tell them that you saw it in RADIO

BY 9IF, GILTNER, NEBR.

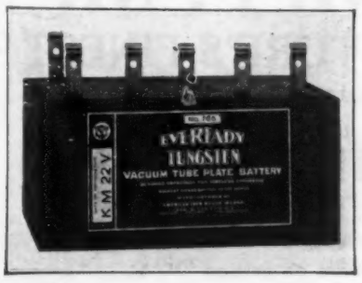
C. W.—1xm, xfi, wubc, nmw, wl2, 2fp, 2xq, 3aln, 3aqr, 3ca, 3bp(c), 3zy, 4el, (4cb-c), 4bf, 4by, 4bq, 4co, 4xf, 4xc, 4ft, 5's too numerous. 6en, 6ef, 6ka, 6ky, 6jd, 6xwl, (6xad), 6za, 7am, 8ajp, 8agl, 8aqh, 8apt, 8aog, (8axk), 8awz, 8ain. 8awm, 8aid. 8atp, 8bx, 8bfx, 8box, 8bo, 8bum, 8bk, 8brl, 8bow, 8bnj, 8bzj, 8bex, 8bet, (8bbk), 8bxx, 8bzc, 8bfx, 8cw, 8ci, 8dr, 8fo, (8ii), 8ib, 8iv, 8iq, 8gl, (8jl), 8ji, 8mp, 8oc, 8oh, 8sp, 8uk, 8uj, 8vj, 8wi, 8wr, 8wk, 8xk, 8xv, 8zz, 8zv, 9's too numerous.

Spark—3bp(c), 5's too numerous. 6ot, 6zz, 6zm, 6za, (7mp), 7ly, 7xb, 7mo, 7zv, 7zu, 7zo, 8ft, 8zn, 8jj, (8bbu), 8zp, 8eb, 8ade, 8ml, 8zac, 8bep, 8brl, 8ars, 8zy, 8xx, 8yn, (8rq), 9's too numerous.

Fones—5zak, 5xp, 5za, 8ajp, 9xm, 9xaf, dd5, kdka, Los Angeles Exchange, Catalina Islands, wrr, wvl.



No. 746. Used in connection with No. 774 for amplification purposes; 108 volts.



No. 766. Eveready Wireless Station Battery standardized for use in U. S. Navy. 16½, 18, 19½, 21 and 22½ volts.

5 SIGNAL FACTS about the Eveready Wireless B Battery

—it lasts longer
Because uniformly high grade materials and refinement of manufacturing processes insure proper working of elements.

—its insulation is perfect
Because each cell is coated with special insulating material, and then further insulated from other cells by means of specially treated waterproof cardboard separators.

—its operation is noiseless
Because of adequate depolarization and steady voltage, perfect connections, and prevention of corrosive punctures and leaks.

—it maintains high voltage
Because ingredients are of proper proportion, and because short circuiting is prevented.

—it gives several positive leads without extra cost
Giving critical voltage adjustment for all types of vacuum tubes.

This 100% Eveready B Battery, linked to your receiving set, will give you more in service—more in satisfaction—than any battery you have hitherto known. See your radio equipment dealer—or write us.

No. 774. The Universal B Battery. One negative and nine positive leads, giving a range of 1½, 3, 4½, 18, 23, 28, 33, 38 and 43 volts.

NATIONAL CARBON CO., Inc.
599 Eighth Street, San Francisco, Cal.
30 East 42d Street, New York City, N. Y.

EVEREADY
FLASHLIGHTS and BATTERIES

NOTE:—*Every wireless operator has use for an Eveready Flashlight*

SEE PAGE 31

RECENT PATENTS

Continued from page 28

16 and 17, and a closed circuit consisting of coil 19 and condenser 18. This closed circuit is tuned to the received waves. A closely coupled coil 21 supplies the input circuit of an audion 35.

C. A. Culver, Pat. No. 1,406,445; Feb. 14, 1922. Photographic receiving apparatus.

A photographic record of the received oscillations is made on a sensitive strip 18 moving at a uniform rate, by means of a mirror 12 mounted on the free end of a flexible reed 8. The reed has very small inertia, while the mirror has comparatively large inertia. The coil 1 acts electro-magnetically to vibrate the reed, the natural period of which may be adjusted for the best effect by the clamp 24-25. A highly flexible connection 13 is placed between the mirror and the reed to increase the angular movement of the mirror when signals are received.

A. N. Goldsmith, Pat. No. 1,404,756; Jan. 31, 1922. Signaling system.

A scheme is disclosed for modulating the oscillations of a high frequency source, such as a pliotron 1. Such a device when causing oscillations to be impressed on a closed circuit 5-6 cannot have its current flow materially varied by a mere variation in the resistance of this circuit. To overcome this difficulty a second pliotron tube 14 is used, having its anode 15 connected to the mid-point 17 of the coil 5, and its cathode 16 by grounds 18 and 8 to the cathode of the first pliotron. Then by varying the potential of the grid 20 of the second pliotron, as by the telephone transmitter 21 coupled to the grid circuit, the oscillations are modulated.

R. A. Heising, Pat. No. 1,406,857; Feb. 14, 1922. Wireless signaling.

An antenna system is described, arranged so that it may either receive or send signals. The scheme here disclosed is for facilitating the change from transmission to reception, or vice versa. This is accomplished by a key 22, controlling contacts 23, and 24, which in turn control relays 25, 26 and 27. The relay 25 causes the antenna 5 to be connected either to the receiving coil 17 or to the secondary of a transmitting coil 13. The relay 26 controls the oscillator 6. The relay 27 controls the detector 18 which when short-circuited by the elements 28, 15 and 30, is rendered inoperative. However, by making resistance 30 variable, it is possible to obtain a side tone when the station is transmitting, and in this way the operator can tell whether the oscillator is working properly.

A vacuum tube, whether used as a detector, amplifier, generator or modulator, consists of three elements inclosed in an evacuated glass receptacle. These elements are known as the filament, the plate and the grid. When the filament is heated by the passage of an electric current from a battery minute negative electrical charges are given off from it and attracted to the plate, which is maintained at a higher voltage than the filament. This flow of electrons constitutes an electric current which may be varied or controlled by another current passing through the grid or screen interposed between the filament and the plate.

A. C. for filament lighting is not satisfactory for a receiving set, as the hum of the usual 60-cycle current is too pronounced without the use of expensive filtering condensers. It is possible, however, to light the filaments from a large storage cell, say of 150-ampere hour capacity, while charging the battery with a vacuum tube rectifier.

THE RADIO WAVE

Continued from page 17

All attempts to produce an antenna or radiation system that would radiate in one direction only, have met with decided failure. The reader can easily see why this is true if the "stress theory" is considered valid. Several types have been produced that have a more or less directive effect and of these the "condenser aerial," lately tested out by the Bureau of Standards, seems to have the most marked directive properties. For amateur installations, however, the T type will be found the best, this type radiating more energy in the directions of its free ends. The L type also has a directive effect; radiating the most energy at the end from which the lead-in is taken. In all types, the directive effect becomes greater when the length of the antenna is increased, and also when it is placed near the ground.

Why these various types show this directive effect is easily explained, for the charge on them is distributed in accordance with the law of electro-statics for the distribution of charges on irregularly shaped bodies.

In connection with the directive properties of various antennae when used for reception, little need be said except of the "loop aerial." When the "loop" is presented to the "field of stress" so that the plane of its windings lies in the direction of the transmitting station, the difference in potential of the opposite sides will cause a current to flow thru the "loop." If the coil is rotated so that its two sides are equidistant from the transmitting station, they will be at very nearly the same potential and no current will flow thru the "loop." Of the other types of directive antennae for reception purposes nothing will be said; all of them owe their directive properties to the way they are constructed in the "field of stress."

The vacuum tube has fully demonstrated its superiority to all other methods of producing undamped oscillations for radio work. We are at present, however, limited to comparatively low power in the ratings of these tubes, due to constructional difficulties, but the writer believes that the course of time will bring about unique improvements which will overcome these difficulties.

The spark and arc oscillation circuits have a tendency to vary constantly in frequency. As these variations are comparatively small, but very rapid and irregular, they have a pronounced effect on the "sharpness" to which stations may be tuned that are trying to receive from such transmitters. This naturally would have a limiting effect on their range.

Another point of superiority of the vacuum tube transmitter is the small amount of power they require to cover extreme distances. An explanation of

this may be found in the following illustration:

Suppose a pendulum is at rest. If we set it in motion we find that it has a natural period of oscillation. If energy is supplied at regular intervals corresponding with its period of oscillation we find that it takes but very little power to keep it in vibration, but if the energy is supplied at irregular intervals, the power expended in keeping the pendulum in motion will be comparatively great.

The same is true of the "field of stress." If we supply energy periodically it will require but very little to keep it in "vibration," but if the supply of energy is erratic, as with spark and arc transmitters, it will be necessary to use a great deal of power to keep the "field of stress" in "vibration."

With C. W. and radiophone transmitters, there are two common annoyances with which every operator is familiar: "swinging" and "fading." "Swinging" is especially noticeable when using the heterodyne method of reception. It is caused either by a change of wavelength of the transmitting station or perhaps more often by the variation of wavelength of the oscillations that are being produced at the receiving station. A swinging antenna is often the cause of the trouble and amateurs will do well to see that the displacement of their antennae during a wind storm is as small as possible. The lead-in, too, should be kept from swaying. At transmitting stations "swinging" is often caused by the variations in the load on the high voltage generator. If possible compensation should be made for this in some way because "swinging" caused by this is often attended with a "fading" of the signals.

"Fading" may also be caused by external conditions and due reference will be made of it later in connection with cosmographical influences which are probably the cause of the greater part of it.

TURNING now to phenomena dependent on cosmographical influences: the effect of the seasons upon the distances covered by transmitting stations will be dealt with first.

If a curve is plotted of the range of a transmitting station during the year, we find that in the months of December, January, and February, a maximum range is obtained. This range falls off abruptly during April, and in the summer months, especially July and August, a minimum is reached. This effect is not so noticeable in the tropics, but in the temperate zones there is a wide range of variation. Probably a great deal of the diminished range during the summer months is due to disturbances caused by static. One investigator considers the range of transmission

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as being inversely proportional to the amount of static in the air. Another claims that the diminished range is due to the leafing out of the trees. Undoubtedly this would have the effect of presenting more surface to the "stress" which would act in a measure to absorb some of its energy. Any of these theories do not violate the principles of the "stress theory," and the writer leaves the amateur to accept or disregard them as he wishes.

Another noticeable phenomenon is the "daylight effect." Often the range of a transmitting station will be increased a hundred times just after sunset and by three o'clock a maximum range is obtained. After this it falls off rather abruptly and with the rising of the sun the range falls off still more.

Most investigators account for this by the absorption of the radio waves due to the sun's action on the atmosphere. It is highly probable that the sunlight causes an ionization of the air which allows the energy of the "field of stress" to "leak" away. Other investigators claim that the sun affects the magnetic lines in the earth and this causes the resultant change in the transmitting range, but the writer would prefer to disregard such theories because they will not apply if the "stress theory" is held valid.

Another very common phenomenon associated with radio communication is the variation in signal strength between various portions of the earth's surface. The data on the subject are meager, but a few general deductions can be arrived at. It is evident that over large bodies of water, radio transmission is attended with little difficulty. On land there seems to be a wide variation in the strength of signals, depending on the direction from which they are received. This is undoubtedly due to the various degrees of conductivity of the earth's surface.

This same explanation will also account for the so-called "bending" and distortion of radio waves by the coast line, which so many observers claim to be true.

Several of the minor phenomena upon which little data can be obtained in connection with this work, are the so-called "magnetic shadows," the auroral displays, and sunspots. That the last two mentioned have some connection with each other is almost certain, but as to their effect on the range of radio communication little can be said. Near the polar regions certain effects might be noticed, but in the temperate zones no definite effects have been observed. "Fading" in the northern latitudes may be caused by auroral displays, but of this we are not certain.

The so-called "magnetic shadows," which spark stations are prone to contend with, are probably due to some

peculiar molecular change in the atmosphere. The "fading" of C. W. and radiophone signals is perhaps due to this phenomena. Similar effects have been noticed in connection with sound waves and the explanation offered, tho not very good, seems to be the only one at hand.

The writer wishes to thank Allan R. Kenworthy, late of the U. S. N., for his aid in compiling the data given in this article.

THE V. T. AS A DETECTOR

Continued from page 23

filament but not the cold grid. With each of the rapidly recurring positive swings, in one group, the grid becomes increasingly negative. The condenser serves to transmit these potentials to the grid, but does not permit the charge which accumulates to leak off. The negative charge accumulated during the reception of one group of waves causes quite a decrease in the plate current. The time between groups of waves allows this charge to leak off through the grid leak, and the process is repeated for each group.

There are two cases in which a grid leak is not needed with a grid condenser. The first is when either the condenser or the base of the tube is not a good insulator, and allows a small current to flow. The second case is when a "soft" detector tube is used. Such tubes contain a small amount of gas, the atoms of which serve as carriers of electric charges in addition to the electrons, with this difference, that they may be either positive or negative. When positive charged atoms, or positive ions, as they are termed, come in contact with the grid they neutralize its negative charge, making a grid leak unnecessary.

In practical work all three of the above methods of detection are generally brought into play, the part each takes depending on the adjustments made and the tube used.

CALLS HEARD

BY 6QQ, SAN FRANCISCO

5za, 5gv, 5fv, (6ak), 6ax, (6ea), 6eb, 6en, (6gy), 6ga, 6ka, 6ky, (6ni), 6nx, 6vm, 6zf, 6zi, 6zq, 6zs, (6zx), 6zz, 6rr, (6alv), 6pk, 6ti, 6ku, (6agp), 6awp, 6bak, 6baw, (6bcr), 6bir, 6bla, 7we, 7go, (7qt), 7dp, 7nx, 7zu, 9pi, 9dtm, 9bro, 9bjb, 9bsg, 9xaq, 9zaf, px, all C. W.

Spark—(7mf), (7oz), 7my, 6zam.

BY 6ZF

C. W.—4bq, 4ft, 4gl, 4zc, 4cb Can., (5za), (7qe), (7xf), (7xg), (cl8), 8jl, 8vy, 8wi, 8xv, 8zg, 8agz, 8axk, 8brl, 9fm, 9pi, 9ps, (9wd), (9wu), (9xi), 9xm, 9bd Can., 9aav, 9aeq, 9aja, 9ayu, 9bji, 9dng, 9dth, 9dtm, (9dva), 9egm, 9xaq, 9zac, (9zaf).

Spark—5ak, 5er, 5if, (5xd), 5yq, (7bc), (7bk), 7ck, (7ge), (7gj), (7il), 7jd 425 meters, (7ke), (7in), (7ly), (7mf), (7mp), 7nw, (7oh), (7ot), (7oz), (7po), (7vo), (7wg), 7xb, 7ya, (7yl), (7zj), (7zm), (7zp), (7zt), (cl8), 9zj.

Feb. 20 (760 miles north Seattle) 7.15 p.m. cq de 6zf (cw) qsa vry; 9 p.m. Seattle P. I.; 9.30 p.m. 6zx (?) spk qsa but qva bad.

Feb. 21 (850 miles north Seattle) 8.15 p.m. kwg Stockton; 8.40 p.m. Seattle P. I.; 8.50 p.m. some other Calif. station but unable make out call or where. 9.10 p.m. 6km de 7mf spk; 9.12 p.m. 7mf de 6km spk; 9.14 p.m. 7zm de 7ed qsa vry spk; 9.18 p.m. 6eu de 6km qsa vry spk; 9.21 p.m. 6vx wrking qsa; 9.23 p.m. 6atq de 7mf; 9.57 p.m. cq de 6zf (cw); (cannot copy cw account qrm fm ships generator.)

RADIO STORAGE BATTERIES

Continued from page 20

simply a continuous charge at a very low rate, which keeps the battery in first class condition at all times, and stops the deterioration usually experienced when a battery is left without a proper charge. This trickle charge varies in quantity for different sizes of cells, but rarely exceeds a half an ampere, even for the largest types of cells.

At best, however, a lead battery is a very delicate, tricky thing to handle, and should always have the best of care. Even where the battery has not been discharged, a freshening charge is required, at least once every two weeks, and oftener if the battery does not hold up well. Distilled water should be added at regular intervals, to make up for that lost in evaporation, gassing, which occurs when the battery is charged. The terminals and tops should be kept clean, and no foreign matter allowed to get into the cells at any time, as this will almost certainly ruin them. Naked flames and lights should always be kept away from lead batteries, as the oxygen and hydrogen liberated around the battery will ignite easily, usually with a disastrous explosion which may communicate itself to the whole set of cells, and cause the loss of life and property, the explosion rivalling powder in its force.

THE Edison battery was, when it came out, heralded as "perfect." Unfortunately, those who considered it so were somewhat too hopeful in their claims and dreams. The Edison battery is unquestionably the best for some classes service, everything considered. Where a battery will have a long steady load drawn from it, as a radio set would draw, the Edison battery stands up far better than the lead, provided the battery is used, i. e., charged and discharged often enough to keep it "active." If a set of Edison cells are charged and allowed to remain charged all the time, with occasional freshening charges, they will not deliver their maximum service by any means, altho they will be in no way injured. It is almost impossible to permanently injure an Edison battery unless some foreign substance is put in the cells, or unless they are damaged mechanically.

Edison batteries are as different from the lead-acid type as it is possible to make a thing which serves the same purpose. In the first place, they have for a solution about the strongest "base," or alkaline substance known, potassium hydroxide (and in some cases sodium hydroxide). The solution is generally made of about a 20 per cent solution of potassium hydroxide (the same substance as common "lye"), in distilled water, usually with a small percentage of lithium hydroxide added. The active materials of the plates are not the plates themselves, or a "paste"

applied to them, but is material securely contained inside of nickel plated sheet steel containers. This material consists of flakes of nickel in the positive plate, and iron oxide, iron rust, in the negative. Small sheet steel tubes, made up of perforated, nickel plated steel, are used to hold the nickel, while small perforated "boxes," called "pockets," are used to hold the iron oxide. These various containers are then forced into steel sheet-metal "frames," which compose the plates, which are then made up with hard rubber separators, and the whole cell, composed of positive and negative plates, is enclosed in a steel "can," which is made tight by being electrically welded at all the seams, the only opening left being a small hole, fitted with a cap and cover, which serves as a "filler" opening, and thru which the electrolyte and distilled water is inserted when the cell is in use, and where the gases escape while the cell is charged.

Edison batteries can be subjected to almost untold abuse, and still maintain their normal capacity and activity. The writer has seen the following classes of abuse heaped on the metaphorical "head" of the Edison battery, which lived to tell the tale: A set of Edison cells was stored away in a warm climate by a person ignorant of the proper method of storing batteries, and after five years it was found that all the water had evaporated from the solution, leaving the cells bone dry. Small crystals of potassium hydroxide could be seen clinging to the surface of the plates. The cells were filled with distilled water and allowed to stand over night. Next morning it was found that current could be drawn from the battery, altho it had not been charged while it was in storage. The old solution was dumped out and replaced with new, the battery was given a couple of cycles of charge and discharge at the normal rate, and as far as could be determined, it was as good as ever! Another time it was noted that at a certain radio station there was but one battery supplied for lighting of the filaments of the audions. Plenty of 110 volt dc. current was available, and the 6 volt tray of cells was placed right across the line, without resistance, and a short charge given the cells, lasting about five minutes. No ammeter was available, but the current certainly rose to 150 or 200 amperes. The limit of the charging period was determined by the time necessary to get the solution too hot to make the process safe to continue. This was done about twice a day for several weeks, until a spare battery could be procured, together with the proper charging panel. No serious effects were noted in the actions of this much abused battery, either at the time or later. In general, however, such extreme cases of misuse should be avoided, as it certainly can do the battery no

good, even if there does not appear to be any harm done at the time.

The actual life of an Edison cell is not known. The makers claim they have cases of trucks and small motor driven vehicles in which the batteries operate the truck all day, are charged at night every working day of the year, and after ten years of such service the cells showed a drop of about 10 per cent from their original capacity and seemed capable of another ten years of such service.

For the lighting of filaments for audions and the like, nothing can excel these batteries. They may be left charged, uncharged, partly charged, or in any convenient condition indefinitely without seriously injuring them in any way. If they are to be left for a time, they should be carefully cleaned off, and all loose solution removed from the outside of the steel containers, as this is liable to cause rusting, which will spoil the container, and will necessitate renewal of the steel cans. They should be supplied with distilled water from time to time, when laid up.

After a couple of years' service it will be found that Edison batteries start to lose their capacity, and that they will not hold the charge. This may be remedied by renewing the solution, as follows: Take the whole cell (or tray, if not too heavy) and shake it vigorously, with the old solution inside, and vent cap closed. This should continue for at least five minutes, and more, if possible. Now open the cap, and while the solution is still stirred up, quickly invert the cell, and allow the old solution to run out into a sink, being careful to continue the shaking until the solution is all out of the battery. If the cell is filled with new solution, and charged, it will be found to be as good as new, and it will continue to serve faithfully until about two years more, when the same process should be repeated.

The Edison cell possesses some serious disadvantages, however. It is of comparatively low voltage—1.2 volts being the normal reading on load, when fully charged, as compared to the 2.0 volts of the lead cell (2.08 to be exact). The internal resistance of the Edison cell is also rather high, which effectively prevents the use of the battery in such work as automobile starting systems, where a terrific current is drawn for a short time. A dead short circuit will not injure the battery; it will only run it down. The plates cannot "buckle," like lead ones do, and, except that the solution would probably heat up, no unusual action would be noted around a battery in this condition.

Both types of batteries should always be kept clean, and should be supplied with distilled water, when the solution falls, due to the evaporation, either thru heat or due to gassing on charge. All

leaky jars in a lead battery should be repaired, and all cans on the Edison type should be carefully greased to prevent rusting and the resultant leakage. Naked flames and lights should be kept away from batteries, as explained previously, as both types generate oxygen and hydrogen when charged. In general, but little care will be required to keep a set of cells in proper working order, but if they start to go bad—look out. Usually a bad cell, either sulphated or leaky in a lead battery, or one with exhausted solution, or a leaky can with Edison cells, will indicate that the rest are in nearly the same condition, and all should be gone over at once. Batteries will give excellent service, no matter what type, provided they are given half a chance, and usually their failure can be traced directly to abuse or neglect, which will ruin anything.

A RADIO PRIMER

Continued from page 20

Communication can be carried on between an aeroplane in flight and a submerged submarine. The aerial on the latter may consist of a loop aerial securely fastened on the outside of the ship and insulated or a small coil of wire placed in a compartment on the deck and insulated both from the ship and the water.

It was said that ether waves are subject to absorption and to reflection previously. Both of these effects depend more or less on the wavelength. These waves are both reflected and absorbed by the salt water, but they are able to penetrate to a sufficient depth so that the aerial of a submerged submarine can pick them up. However, the submarine must necessarily use a very short wavelength in transmitting, and inasmuch as the sending aerial is completely surrounded by an absorbing medium, the salt water, only a small part of the radiated energy goes above the surface of the water. The receiving range is therefore much greater than the transmitting range. The shell of the submarine is used as a ground.

One mistake often made is to place the horizontal wires of an aerial too near together. If two wires are placed several inches apart the capacity of the two is not much greater than one alone, but if the distance between them is several feet the capacity is then equal to the sum of two. A good distance between wires is three feet.

You may be asked to suggest a suitable aerial for receiving radio music. The wavelength is usually about 360 meters; the tentative recommendations of the Washington Radio Conference allot 310 to 435 meters for radiophone broadcasting. A single wire inverted "L" outdoor aerial from 100 to 150 feet long will do, insulated at both ends, using water pipe for ground. The higher the aerial the better. The writer would suggest two such wires, spaced about six feet apart, joined at the farther end and the free ends brought into the house through a tube.

An indoor aerial can be used, but it will necessitate the use of amplifiers to bring the signals in at good strength. An insulated wire behind the picture molding will serve.

Insulated wire may be used outside, but stranded, bare wire is better.

The Radio Conference will reconvene at Washington about May 1 to consider suggestions from private and government broadcasting interests who believe that changes should be made in the preliminary recommendations on radio telephony. There is a possibility of change in the proposed allocations of bands.

CONSTRUCTION OF 100 WATT TRANSMITTER

Continued from page 14

drilling a ¼ in. hole at the top and bottom of each slot and sawing out the material between them with a coarse hack-saw blade. The edges are rounded with a half-round file and smoothed by pulling emery cloth back and forth through the slot. The holes for the meters can be roughed out by drilling holes around the rim, the rough hole being finished with a half-round file.

The base is a piece of hardwood, preferably mahogany or walnut, although gum finishes up well. The edges are beveled and the top and edges sanded. A good dark mahogany wood dye should be applied with a cloth and rubbed until quite dry. Three coats of white shellac with light sanding between each coat are next applied. When quite dry and hard the shellac should be rubbed dull with pumice and gasoline, using a stiff brush such as a nail brush. This treatment should be followed by a brisk rubbing with the palm of the hand to remove all vestige of pumice. A flow coat of a good spar or furniture varnish will result in a high gloss that will not scratch easily.

The side brackets should be bent as illustrated, the bottom serving to strengthen the board and prevent it from warping. They can be easily formed as follows: On a piece of steel 26½ in. long a file or center punch mark is made 3 in. from one end and another 9½ in. from the opposite end. The steel is then heated to redness in the region of the mark and cooled by dipping in water for a space of ¼ in. on each side of the mark and bending to a chalk line laid out from the drawing.

The panel should now be screwed to the base and squared up. The brackets should be formed to fit both the panel and the base and the holes marked through the holes previously drilled in the panel. This insures perfect alignment so that, in the next operation, the brackets may be screwed into place.

The rheostat should be mounted next, with a piece of blotting paper between it and the panel to prevent cracking the base when it is fastened in place.

The tube sockets are mounted on bakelite rings so that additional working space is provided for the passage of wires, etc. Blotting paper is placed between the bakelite ring and the socket to prevent breakage as in the case of the rheostat. The sockets are placed so that the grid connection is nearest to the panel, the filament connections are parallel with the panel, and the plate connections are nearest the bridge.

The bridge is next assembled and screwed into place with the shorter fiber tubes as spacers, No. 6 wood screws 2 in. long being used.

The meters should come next, the antenna meter being on the left, 8/32 round head nickel screws and hex. nuts being used. The screens are fastened on by means of escutcheon pins driven tightly into drilled holes.

The inductance is spaced from the panel by fiber tubing and screwed into place, the top level with the top of the panel, No. 8 wood screws, 3 in. long being used. In order to make wiring simpler the top clip and its mounting are placed, as indicated in the drawing, on the other side of the inductance near the center.

The set is now ready for wiring. The high frequency leads are of 1/16 by ½ in. copper strip. These connect the radiation ammeter with the antenna binding post at the upper left hand corner of the panel, as well as the radiation meter with the top of the inductance. The remaining high frequency lead connects the bottom tap of the inductance with the ground binding post in the lower left hand corner of the panel. The remainder of the wiring is No. 12 hard-drawn copper wire through varnished cambric sleeving. The leads should be neatly formed to connect the various elements of the circuit by the most direct path. This is best accomplished by studying the wiring diagram, Fig. 1.

If these simple directions, as well as the data contained in the drawing, are followed the resulting apparatus cannot be other than a source of real satisfaction to the constructor.

SPECIFICATIONS AND COSTS

1	R.C. U.P. 1016 transformer	$38.50
1	R.C. P.T. 537 rheostat	10.00
2	R.C. U.R. 541 tube sockets	5.00
2	R.C. U.V. 203 tubes	60.00
2	R.C. U.C. 1806 condensers	14.00
1	key	2.50
1	0-10 radiation ammeter—Jewell 64	12.40
1	0-15 a.c. voltmeter—Jewell 74	8.00
1	RC. UL. 1008 oscillation transformer	11.00
2	D.L. 250 radio frequency chokes	2.80
1	bakelite panel 3/16x16x16½"	10.50
1	bakelite bridge 3/16x3⅜x14"	.90
2	bakelite disc. 2⅞" dia., 3/16" thick	.30
2	bakelite disc. 3¾" dia., ⅜" thick	.50
16"	fiber tubing ¾" diameter	.75
1	brass screen ⅛" mesh, 4"x6"	.50
1	brass or copper 1/16"x½"x20"	.30
8	heavy binding posts	2.00
20	ft. hard-drawn copper wire No. 12	.20
20	ft. cambric tubing for No. 12 wire	3.00
12	screws, machine, flat head 10-32x1½	.24
6	10-32x¾	.12
6	screws rd. head nickel, 6-32x⅝	.18
	Screws, rd. head brass—	
6	8-32x⅝"	.12
6	8-32x¾"	.12
	Nuts, hex. brass—	
18	10-32	.18
12	8-32	.12
6	6-32	.06
	Washers, brass—	
24	10-32	.10
12	8-32	.05
	Wood screws, flat head iron—	
6	No. 8x3"	.05
6	No. 6x2"	.05
6	No. 6x1½"	.05
6	ft. cold rolled steel 3/16x⅛"	.60
1	base, mahogany or walnut, ¾x12x16½"	1.25
Paint, varnish, sand paper, nickeling, etc.		1.50
	Cost of all material at retail prices	$187.94

Royalties on radio music are being demanded by music producers, it is announced by William Rossiter, music publisher. Negotiations for collection of a tax from all radio-sending stations have been started with the Westinghouse Electric Company in New Jersey by the American Association of Authors, Composers and Publishers, he said. Tremendous inroads on the sales of phonograph records and sheet music have already been made, declared Mr. Rossiter. "If the present movement is carried to its logical conclusion," he asserted, "it will wipe out the phonograph and music publishing business." People figure, he explained, that by spending $15 or $20 putting in a radio receiving set they can avoid buying expensive phonographs and constantly buying new records. The demand for royalties on radio reproduction, he said, is in line with the tax that has been collected for years by the association from theaters, dance halls, cabarets and other places where music is reproduced for profit. The royalties collected are divided three times a year, said Mr. Rossiter, and through the publishing house, the author, the composer and the artist all receive their shares.

Church chime music by wireless is the new diversion of those owning radio receiving sets within a fifty-mile radius of Rochester, N. Y. A transmitting station installed by the Lake Avenue Baptist Church sends out the music from the Deagan electrically operated chimes in the church tower. This suggestion will undoubtedly be followed by other broadcasting stations situated near chimes which are operated at regular periods. This form of music appears to be well adapted to broadcasting as it is greatly enjoyed by the listeners-in. One enterprising circus management is reported to be seeking an opportunity to broadcast the sounds of the steam calliope!

A PHONEY FREEZE-OUT

Continued from page 19

"I tell ya, we're done fer," wails Hell-Fire, as we watch the K-V-I phone go in. "Anybody can see this rig is gonna *work!* They're usin' our big four-hundred foot aerials, an' our old eighteen-hundred meter wave. An' when I look at them rows of evacuated glass cannons, I can see it ain't for nothin' that th' aerial-ammeter is calibrated to read to thirty amperes! They're gonna slam th' needle right up onto th' end of th' scale!"

"Yes," I agrees, thoughtful-like. "Yes, I s'pose they will."

"Then whadda' ya sittin' around here lookin' so d——d peaceful fer!" howls Hell-Fire. "Why don't ya git excited or somethin'! Don't ya think these rigs are gonna work! Don't ya know th' tube hounds in th' States are puttin' across weddin' invitations an' home-brew recipes from Catalina t' Chicago on twenty watts—an' here's a thousand watts to upholster th' vocal disturbances 'a th' fish-barons across just three-hundred miles—of water! Th' farthest cannery up th' peninsula ain't more'n five-hundred miles from N-P-Q. I tell ya, these things are gonna come in like a stewed six-foot Oregon lumber-jack war-hoopin' in your ear with a megaphone as big as a road-culvert!"

"Well, it's no use ravin' that way about it," I yawns. "Let's get Old Judge an' have a little game."

THE testing of the phone set at K-V-I was a grand success. Working on hardly half-power, it carried strong across the three-hundred-mile stretch to N-P-Q. After showin' the Brainless Swede how to run it, Mr. Aloysius Bean leaves him an instruction-book, an' then goes on to put in the next phone over at K-O-X-N, Hell-Fire's hang-out.

When Old Judge officially gets th' can at K-V-I, he is pretty glum.

"I know I'll never get back there again," he announces, mournful-like. "Th' phone company are takin' out all th' spark outfits as part payment on th' tube sets. An' th' phone is workin'. Th' Brainless Swede gets th' N-P-Q radio-phone on a regular daily schedule; an' after he clears his business, th' navy fella reports back th' message charges, which th' Swede puts down on his abstract sheet. Nothin' to it!"

I sends word to all the brasspounders along the line to come down to Unga when they get fired, an' they soon begin driftin' in pretty steady. Old Judge, who is th' town postmaster an' everything else, has a fairly good-sized shack, of which we summarily proceed to take possession. We make a barracks out of his combined court an' post-office room, a mess-hall out of his kitchen, an' a loungin'-room out of his private smoke-den. Old Judge has a nifty ham set, a big vic-

trola, an' a lot of high-class records, all of which we put into use.

We had a nice time. Music an' song, a blindin' fog of tobacco-smoke, poker-chips, nightly rough-house initiations into a Skull-Bones Lodge, an' dances in th' Unga dance-hall. Everybody chips into a general chow fund, Old Judge an' some of th' other culinary gooneys do th' cookin', an' nobody washed th' dishes. We enjoys knotted sleepin'-blankets, shoes nailed to th' floor, sleep-walkers, an' a spark-coil shockin' rig on all th' door-knobs. In three weeks, th' joint looks like a Chink lodgin'-house struck by a typhoon.

We keep a listenin' watch on Old Judge's ham set; an' long before all the phones are installed, th' bunch begins to see the idea of stickin' around. One or two phones went fine, but when fifteen or twenty of 'em gets on the air, an' more comin' all the time, trouble begins. The boss of the King-Salmon company overhears some Alaskan Fisheries' private dope about a band of natives comin' down from Nome to fish; an' the King-Salmon outfit rush boats out an' beat the other people to 'em. Then the Pacific-American crowd spot a big run 'a fish at Herendeen; but the Great Northern gang, gettin' wind of it by eavesdropping on the phone, sneaks down an' cleans up all th' fish. A few days later some personal stuff trickles into th' receivers of a fish-hound who is bein' slandered, an' there is a fight; then some feministic scandal leaks out which causes a shootin' scrap.

Pretty soon th' whole outfit blossoms out with a bunch of secret codes. And then *real* trouble starts. Puttin' coded stuff over telegraph is bad enough—but over a phone. Try it!

While th' gob at N-P-Q was takin' straight stuff from a few phones, he got along fine, but now with twenty-eight on his over-worked neck an' everything comin' in code, he begins to get pretty savage. Listenin' in on Old Judge's set one mornin', when the Brainless Swede is tryin' to get off his business, we hears th' first powwow.

"Squeeche, trowback, Kinooschi, wiolence, vaffle—you bane hear, yes?"

"Hear what!" snarls th' gob. "A tongue-twisted Hungarian peddlin' oysters, or a moon-struck Eskimo sobbin' a funeral dirge! Is it squeejee, throwback—how do ya spell that third one?"

"K-o-n-i-u-j-i. Das Koniuji Island."

"Koniuji, violence, waffle?"

"Yus. Pulwerized, spoonfish, floosk."

Before the gob has time to digest this, another fish-magnet up Naknek way comes slammin' on th' air.

"Say, there, are you going to spend the rest of the month on that cursed message?" he fumes. "I can't stay here this way with the river full of salmon—my time is money!"

"Well, ya just gott'a wait, mister sal-

mon-snatcher!" barks th' gob, hostile-like. "There's eight watin' their turns yet before you. Ya better get a bookkeeper to th' phone if you're so doggone busy. Now, Unga, go ahead, pulverized, spawnfish, flush."

"Listen here, I don't want any of your lip, you navy fellow," snaps th' Naknek cannery-king, before the Brainless Swede can get back in. "The bookkeepers are working fourteen hours a day now—we've got nobody to sit here all day with this thing!"

"Ach, dunnerwetter!" rumbles th' thick, mushy note of old Rudolph Krugscaller, th' codfish-kaiser at Hell-Fire's hang-out. "Blease, mister Nicknack und shut up! Did you think you iss der only one standing all der time here mit pizness fizzling by der finkers, yes! It's for fishink I'm also, und chabbering all day, not!"

"I can't stay here with you guys any more now," busts in th' gob. "It's time fer my arc schedule with Cordova. See you all at eight tonight—g'bye."

About a dozen phones come yellin' on the air at the same time, but it was no use. The gob was gone.

"I've had enough of this, dammit!" boils th' Naknek salmon-packer. "Hello, Unga, are you still there?"

"Yus—and Ay skall vait hyar even it bane vun veek, by golly!"

"I understand the operators are all down there at Unga—please tell our man we'd like him to come back up here—right away!"

"HURRAH!" whoops Fatty Gibbs, th' Naknek brasspounder, who is listenin' in with me—an' he makes a dive for his suit-case.

"You needn't be in such a rush to submerge your safety-razor under your other shirt, Fat," I advises him. "You're gonna be here with us a good while yet."

"How so!" demands Fat, a big striped necktie in one fist an' a pink undershirt in th' other—like a decorated balloon. "They said fer me to come back, didn't they?"

"Yes, sure, but you're not goin'—not right away. You've got to wait fer th' rest of th' bunch."

That night Fat tries to make a getaway, but he stumbles over a wash-tub full a' dirty dishes an' goes down with a crash that brings th' whole gang flyin' out 'a their blankets to see if it's 'a earthquake. Capturin' Fat, we confiscates his striped yellow tie an' lock it up in Old Judge's safe, which we know will keep him with us till we're ready for him to go.

In another two weeks, about half the cannery outfits have sent word they want their ether-jammers to come back.

"You gotta wait!" I declares to th' bunch, when some of 'em begin to get anxious to go. "If half you brasspound-

ers go back on th' job now, it'll clear th' air enough so th' rest of th' fish-barons will get their business through. Let 'em yell an' rave till they *all* give up. United we stand, divided we don't eat!"

THE salmon-packers find out that runnin' a big radiophone is more than pushin' a button. A gale takes down an aerial; an' when it is put up again, the set is out of tune an' out of the game for two weeks till Mr. Aloysius Bean can get to it; another interference-smasher ran up his filament current an' burnt out his tubes; one lost his instruction-book an' forgot how to start up; another, foolin' around with the current on, got his hand on the 2500-volt plate-circuit, an' went to th' cannery hospital. When he gets out, he sends Mr. Aloysius Bean to the same place for not tellin' him th' thing was dangerous.

Things on the air got snarled up worse every day. Schedules shot to pieces; two dozen fightin'-mad fish-hounds chewin' th' corners off their desks; an' th' gob at N-P-Q on th' point of hydrophobia.

At last th' whole crowd give it up as a bad job—all but old Krugscaller an' the Brainless Swede. These two keep hangin' on, day after day, and as all the other fish-magnets are howlin' for the key-punchers to come back, I decides it's necessary to do somethin'.

Happenin' to know that the marshal has a confiscated stock of Canadian real-stuff, we pulls off a sham-battle in th' dance-hall one night an' gets him away from his shack long enough to break in an' grab a case—or two. The Naknek salmon-packer had sent his big tub-boat *"Shelikoff"* down to Unga with orders to bring back Fat; and I takes the case of glassware down to the skipper.

"If you go back home without Fat, you'll probably get killed, won't you?" I remarks, as a preliminary.

"I ain't goin' back without him!" yells th' tug-boat navigator, spittin' a shovelful 'a chewin'-tobacco over the lee rail. "If you'd 'a heard what th' boss said——"

"Well, here's a proposition," I cuts in. "Take this box up to th' navy operator at Pribiloff; then come back, an' we'll let Fat go with you."

"Yep, sure, you betcha I'll take it!" exclaims th' skipper, makin' a grab fer th' box. "Say, if you'd 'a heard what the boss said——"

"Handle it careful," I warns him. "It's full 'a delicate—wireless instruments."

TWO evenings later, we hears th' Brainless Swede an' old Krugscaller havin' their usual row about who is goin' to clear first.

"You ha' no business talking over

dar except Ay bane tru here first already!" howls th' Swede. "Das navy yentleman ha telled you before t' kip qviet ven Ay bane talkin', by golly!"

"Ach, himmel! All night you iss hollering und it's schwearing here I'm because it's talking not English you spoke, but Swede chabber. Doesn't der opberator told you already your bronunziation iss so sweet, like a funeral singing in Lapland, yes!"

Before the Brainless Swede can get back on this, th' gob comes on the air, gloriously hooked up to our case of—wireless instruments.

"Hic—hullo there Dushy an' Sweedie, ol' dears," he chirrups, lovin'-like. "Glad t' see th' battle 'a wind an' words is, hic—howlin' its merry way along this evenin'. I'm jesh enjoyin' a beaushiful preshent some darlin' angelsh shent me today, an' I'm sh' happy I'm just about ready t' climb up th' wirelesh mast an' fly away t' heaven! Say, I guessh long's we're gonna be here all night t'night, we mightsh well have a little mushik—eh, Sweedie! I got shome new records hic—here, an' I'll stick th' trans—transhmisher up to th' phonograph sh's we can all enjoy thesh pashin' idle hours—huh Dushy!"

Sure enough, we can hear the gob crankin' up his music-box; an' then over the air there comes a horrific squawkin' like a duet sung by a colicky mule an' a jealous tom-cat. At last th' thing clatters to a welcome end.

"Fellas, that wash 'Th' Moonshine's Hid in th' Cowshed,' shung by Frenzied Wheelbarrows an' Hollar Louder. I got dozensh more 'a thesh pretty shongs, an' if th' anglesh preshent holds out, I'm gonna play 'em all. Let th' benifishunt harmonies be shung to all th' world, thanksh to th' two greatest modern invenshuns shience has given to man! Just a minute an' we'll have another."

"Say, nix, mister Briploff," pleads old Krugscaller, after th' happy gob has perpetrated four or five more unmusical outrages on th' agonized ether. "Moosik iss moosik, but pizness iss greenpacks, und fishing all day iss no sleepings—pesides der pooks iss not keeped today yet to be twiddle-finkering at midnight by der tellingfoam here, und der wife says to come right aways to bed in."

"Aw, whash th' use 'a bein' so hic—huffy, when we're all havin' shush a grand celebrashun, Dushy," grumbles th' gob. "Ash codfish-snailers, you an' Sweedie ol' dear are a fine pair 'a hic—hooks, but when it comes to wireless concerts, you don't know th' difference between Crusho's 'Vermishelli' an' a scandal in a boiler-shop. That lash shong was 'Las Tickly Crocodillas,' shrieked by Gallopin' Curses. Jush a minute an' we'll have another."

"Dumkopf!" explodes old Krugscaller. "It's finished I'm tellyfoaming by

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CAPITAL RADIO SUPPLY COMPANY, Inc.

Indianapolis, U. S. A.

navy slobs crazy mit phonographs und singing all der night out like nightmares und chackass deliriums! Codfish brains goes by codfishing, und wireless opberators goes by midnight electrics und lying all der night up mit hollering und loose talking-machine screws! It's under der bed already I'm in!

That settles Dutchy; but the Brainless Swede still sticks. About two o'clock in th' mornin' the gob goes to sleep with his set runnin'; an' he seems to have left his transmitter lyin' on a table or somethin' near his head, because we can hear him snorin' on th' air, like a distant rumblin' 'a autumn thunder. Th' Swede keeps yellin' away, tryin' to wake him up, until Hell-Fire slips out to the K-V-I engine-house with a bucket of water, an' dumps it in th' gasoline-tank.

Pretty soon th' old gas-mule gives a couple 'a consumptive chugs, splutters an' sucks wind, an' then dies stone-dead. An hour later, th' Swede comes dashin' over to our peacefully-sleepin' camp, wild-eyed an' cursin'.

"Yumpin snakes! After Ay bane vaiting whole night das navy stewbum vent avay before I vas speaking vun vord of fivf messages I vas writing tree days already yet, and now das gasoline engine stopped vorking, but for vy, I can't see! By golly, Ay bane qvit!"

THE next morning, I takes charge of the Swede's phone an' spreads a general call to all th' fish-barons to be on th' job at eight o'clock. That night, with all th' brasspounders that can squeeze into th' shack crowded around, I calls a roll; an' there is a hundred-percent attendance on th' air.

"Now then, we're ready to talk business," I commences. "After tryin' to be your own operators for three months, you've found out you're like a bunch 'a blacksmiths tryin' to tailor their own suits. Small phone sets can be run by anybody, even salmon-packers, but outfits the size of these take as good 'a operator to handle 'em an' keep 'em perkin' as a telegraph set does. Handlin' commercial business takes somebody's time, anyway; you can't always sit down an' clear right away, no matter how clever you are; an' if there's a heavy jam on th' air, an' you don't know th' game, you won't clear a'tall.

"Handlin' business telegrams over a phone ain't satisfactory, especially when they're full 'a names an' words hard to spell. Besides, nobody wants his private business shouted a thousand miles around with ten hundred million people stickin' up aerials to hear it; an' puttin' code an' cipher over a radiophone would turn a psalm-singer into a cursin' maniac inside of a week—even th' Brainless Swede here admits that.

"Th' tube sets are all right, an' can't be beat, but we'll have to put in circuits to handle th' business on undamped tele-

TURN TO PAGE 31

graph—not telephone. Now, to put in these circuits will cost you—wait a minute——"

I covers the transmitter-mouthpiece with my hand, an' turns to the bunch crowded around.

"How much have we spent for grub an' stuff since we been here?" I asks.

"Nearly twenty-four hundred bucks," replies Hell-Fire, who has th' figures. "About eighty-six plunks apiece."

"All right, say ninety dollars," I rejoins. "To put in key-circuits on these sets won't cost nothin' but five dollars each for th' sendin' keys."

I takes my hand off the transmitter.

"To put in these circuits on your phone sets will cost five dollars apiece for telegraph keys an' ninety dollars for —for th' rest of th' apparatus an' things we have to get. Th' operators will leave tonight on th' *'Shelikoff'*; and as each one will hook up his own key-circuit, all you have to do is to each pay your own operator ninety-five simoleons for th' stuff we have to furnish. Now, is this O. K.?"

"Yes!"

Twenty-eight 1000-watt tube sets in at once knocked th' phones clean off my bean.

AND that is really the end of the story. The extra tube set that was in N-P-Q is now in Old Judge's den beside his amateur set; and on Sunday afternoons, when the Alaskan air is drowsy and peaceful, twenty-eight brass-pounders lean back in their chairs and enjoy a musical concert played on Old Judge's phonograph. Tune up around eighteen-hundred meters some quiet Sunday evening, and, if your set is good enough, you'll probably hear it.

NEWS OF RADIO BROADCASTING STATIONS

Continued from page 25

"Athletics," by Clarence P. Houston, Assistant Professor of Physical Education and a former Tufts football star; "The Story of the Bridge Builder," by Professor Edward H. Rockwell; "The Conservation of Bird Life," by Dr. Herbert V. Neal; "College Music," by Professor Leo R. Lewis. This lecture will be illustrated with selections by the Tufts College Glee Club. Professor Albert H. Gilmer will speak on "The Modern Drama," and Dean Lee Sullivan McCollester of the Crane Theological School will speak on "The Place of the Minister in Modern Society." A speaker to be selected by the Dean of the Dental School will treat the subject "The Relation of Dentistry to Medicine."

Although it is impossible to give the exact dates of the lectures, the entire course of 13 will be complete before May 1.

In the initial statement it was made clear that the lectures would be of a popular nature and not beyond the understanding of the thousands of young men and boys between the ages of 15 and 25 who are especially interested in wireless. Also the lectures will not exceed 30 minutes in length and will be delivered in such a way that "students" can take notes if desired. Some of the lectures will be given in the afternoon in order that women, many of whom are taking an interest in the radio telephone, may listen.

SEATTLE TO THE FRONT

Seattle, Wash., is awakening to the fact that there is such a thing as radio. Here are some of the recent developments:

The radiophone operated by the Northern Electric and Radio Co., in conjunction with the Seattle Post-Intelligencer, which has been giving concerts and news items for some time, is now transmitting several times a day. Aerials on house tops are becoming more common than the clothes line in the back yard. A very recent issue of one of the largest daily newspapers says:

"A new broadcasting station is to be operated here by Mr. V. I. Craft, and will give nightly concerts and press reports on 360 meters. The Times will have a set with a Magnavox at 1635 Westlake Ave., that will be in operation every Wednesday night, so the public can hear what is in the air.

"Since January 1 radiophone receiving sets have increased in use in Seattle by 100 per cent, according to the leading authority. He estimated that a thousand sets are now in operation in this city. A thousand sets means that ten times that number are daily hearing talk by wireless."

A dance was recently held at Camp Lewis, where the music was furnished by a Seattle radiophone. Another will be held at Alki Point which will depend on the radiophone for music. Recently a series of sermons was sent from the Catholic Church by radiophone. This series of lectures lasted a week.

BY WALTER HEMRICH, NORTH COAST PRODUCTS CO., ABERDEEN, WASH.

4cb, 6aau, 6abm, 6abx, 6aix 6ajr, 6alk, 6atk, 6ate, 6atu, 6ark, 6awr, 6cp, 6cq, 6ed, 6gr, 6gy, 6ic, 6qr, 6tu, 6vx, 6zf, 6zx, 6zam, 7ck, 7ge, 7jw, 7ke, 7ks, 7ln, 7ly, 7mf, 7mp, 7nz, 7nf, 7om, 7ot, 7ri, 7tj, 7vo, 7ya.

BY 6ASB, D. V. RUSSELL, BVA, CALIF.

Spark—5xd, 5za, 5ze, 6bd, 6bp, 6gr, 6gt, 6gy, 6hc, 6hp, 6ib, 6kc, 6ok, 6ob, 6pk, 6pj, 6qr, 6to, 6tu, 6tv, 6tc, 6vk, 6vx, 6xf, 6zi, 6zd, 6zu, 6zx, 6zz, 6zaj, 6zam, 6aak, 6aah, 6aau, 6abr, 6abu, 6acr, 6afd, 6afp, 6ahf, 6ain, 6ajh, 6ajr, 6ala, 8alr, 6amk, 6amw, 6amy, 6ams, 6aoe, 6aor, 6aqy, 6ard, 6ark, 6arx, 6ath, 6atq, 6bak, 6bam, 6bfg, 6liu, 7bp, 7eb, 7fj, 7ic, 7iw, (7jd), 7kc, 7mf, 7mp, 7mt, 7oh, 7vo, 7xa, 7ya, 7zm, 7zt.
C. W.—3fw, 5za, 6amd, 6bfp, 9db, 9hc.

BY C. C. WHYSALL, 8CMI, MARION, OHIO

1boq, 1ze, 1zak, 2el, 2fp, 2om, 3auw, 3dm, 3eh, 3xm, 4bk, 4bq, 4ft, 4gm, 4gn, 5aab, 5bm, 5by, 5fo, 5hk, 5lo, 5lw, 5py, 5uc, 5xz, 5zak, 8afb, 8aje, 8ajx, 8axk, 8ars, 8atu, 8ayx, 8anb, 8aoi, 8awu, 8bys, 8bq, 8bis, 8bfh, 8bxx, 8baz, 8cbe, 8daf, 8eb, 8hg, 8ib, 8ls, 8qq, 8rq, 8uc, 8vj cw, 8wz, 8xe, 8xv, 8yae, 8yk, 8ym, 8za, 8zp, 8zx, 9aaj, 9aas, 9aap, 9aeg, 9agr, 9acn, 9aif, 9ajh, 9aiu, 9aoe, 9aye, 9bp, 9dqq, 9dsd, 9dmj, 9dxi, 9dwp, 9dso, 9dfx, 9dug, 9hr, 9ki, 9lf, 9ms, 9uu, 9vl, 9xi, 9xt, 9xm, 9yb, 9yq 9zj, 9zx.

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FOL SALE: $300 500 cycle spark transmitter for $100 cash. Consists of ½ HP 3600 AC motor, generator and exciter switchboard with 500 cycle and 60 cycle volt and ammeters field rheostat and switches. Transmitter panel with Dubilier, O. T. transformer, quenched gap and radiation ammeter all mounted on bakelite. Spare armature, gaps and transformer go with the set. All above in good working condition. F. A. Brandis, 6IK, 1039 Merced, Berkeley, Cal.

FOR SALE CHEAP or exchange for C. W. apparatus: ¼ HP synchronous motor and Hyrad Disc. 6ACM, 1551 Emerson St., Palo Alto, Calif.

RECEIVING APPARATUS

ONE RADIO MAGNAVOX $45.00, used only few weeks. Reason for selling, going out of radio business. Sacrifice for $35.00. Perfect condition. J. B. Brun, 1701 Franklin St., San Francisco.

A BARGAIN: I. P. 500 Navy Standard Receiver, $160.00. 7KR, 528 Market, Portland. Ore.

VARIOCOUPLER PARTS: Hardwood rotors, 45c; stators, 60c; complete variocoupler, $3.50. Include postage. Louis Griewisch, 301 South Oakland, Green Bay, Wisc.

VARIOCOUPLER PARTS: Hardwood rotors, wound, 95c; stators wound, $1.00. Include postage. Louis Griewisch, 301 South Oakland, Green Bay, Wisc.

600-20,000 meter receiver including Radiotron, $35.00. 150-600 meter receiver including Radiotron, $35.00. Box 205, Williamsport, Penna.

3 LONG WAVE TUNERS, $2.00 each. 2 spark coils, $1.00 each. 1 Murdock tuning coil, $3.00. 1 Electro tuning coil, $2.00. 3 Murdock .001 variable condensers, $2.50 each. 1 Murdock .0005 variable, $2.00. Practice key, 30c; Martyn Coony, 475 30th St., San Francisco.

OCCASION. A complete Audion Receiving Set: Inductances, Primary and Secondary Condensers, Series and Parallel Switch, variable Grid-Leak, four Dials, A and B battery switches, Weston Ammeter and Voltmeter, Bakelite panel (B battery included). The whole enclosed in a polished mahogany case, with snap fasteners and lock and key—14x10x8 in. Range: 200 to 2500 meters. (Radio Concerts and Time-signals.) Price $40.00. Inspection and testing invited. C. E. W., 2630 Ridge Road, Berkeley, Cal.

Loop Antennae. With a vacuum tube set this Loop Antenna will receive radio without the need of an aerial on the roof. 3½ feet high, shipped knocked down, postpaid on receipt $2.50 money order. P. Anico, 421A West 26th Street, New York.

FOR TRADE: Two new $6 variometers for phones, tubes or other radio. R. W. Haynes, 1236 American Ave., Long Beach, Calif.

Must sell! Short wave REGENERATIVE RECEIVER for $35; cost $60. R. W. Haynes, 1236 American Ave., Long Beach, Calif.

FOR SALE: Short wave regenerative receiver, 150-600 meters. Brand new and fully guaranteed. Reasonable. Phone West 1357, San Francisco.

Bargain: Receiver and two step amplifier, $50. Crystal receiver including pair phones, $10. Two step amplifier, value $60, sell for $30. Magnavox, storage battery, rectifier, etc. H. E. Williams, 1319 Napa street, Vallejo, California.

RADIO STORAGE BATTERIES. 30 A. H. 2V. $1.70 per cell. Guarantee for 1 year. Order at once. You take no chances. Howard Hunt, Box 108, Macedonia, Ohio.

MISCELLANEOUS

Trade for radio: Remington 12A repeating rifle; sell $15; Blickensderfer Typewriter $10. Charles Vanderpool, Madill, Okla.

FOR SALE OR TRADE: 1/12 H. P. 3400 Revolution Westinghouse motor. Need loud speaker. Postoffice Box 128, Menlo Park, Calif.

BUILD RADIO SETS. We supply parts or complete units. Catalog 15 cents. Easily understood assembly drawings Crystal Detector Set, Non-regenerative Receiver, Regenerative Receiver, 2 Step Amplifier 25 cents EACH. All five $1.00. No stamps accepted. Hatfield Airfone Company, Owego, N. Y.

"A" BATTERY SALE—Have several new and rebuilt storage batteries, $6.00 up. New 6v nine plate radio batteries, $18.00. Farwell Battery Station, 2240 Russell St., Berkeley, Cal.

STOP! LOOK! and ACT! V. T.'s ACCESSORIES! With each of the listed tubes RADIOTRON U.V.200, $5.00, and A. P. MOORHEAD detectors $5.00; RADIOTRON U.V.201 $6.50, and A. P. Amplifiers, $6.50, we will supply free of charge your choice of either of these 5 premiums—latest FADA rheostat, $1.00; Paragon V. T. socket, $1.00; Murdock socket, $1.00; DeForest V. T. socket, $1.00; Remler rheostat, $1.00. Either of the FEDERAL single, closed or double circuit jacks listed respectively at 70c, 85c, and $1.00, will be given as premiums with each FEDERAL 226W or R. C. of A. U.V.712 amplifying transformers, $7.00 each. U.R.1714 Radio Frequency amplifying transformer. FADA 5 ampere NICHROME Thermoplax, power rheostat $1.35 or R. C. of A. U.R.542 porcelain V. T. socket will be given as premiums with each $8.00 U.V.202 power tube or A. P. MOORHEAD 5-watt Type C power tube, $7.50 each for C. W. or Radiophone transmission or power amplification. We absolutely guarantee the foregoing apparatus. Only new and high grade equipment carried in stock. Unsatisfactory goods subject to return within five days. 12 hour service or your remittance returned. Postage and insurance prepaid by us, thereby saving time and money. Remember us. THE KEHLER RADIO LABORATORIES, Dept. P., Abilene, Kansas.

CABINETS—High grade cabinets at reasonable prices. Cabinets made to order. Send sketch or full details for prices. Panels cut and drilled. Prompt service. Marvin Fallgatter, Waupaca, Wis.

INSTRUCTION

BKUMA YRLSBUG—TWO HUNDRED beginners tell how memorized wireless code in thirty minutes to two hours. Booklet, 10 red stamps. Dodge. Box 220, Mamaroneck, N. Y.

TELEGRAPHY—(Morse and Wireless) and Railway Accounting taught thoroughly; big salaries; great opportunities. Oldest, largest school. All expenses low—can earn large part. Catalogue free. DODGE'S INSTITUTE, Hass St., Valparaiso, Indiana.

RADIO BOOKS

"Arc Radio Manual," published by the engineers of the Federal Telegraph Company of San Francisco, and written in simple, interesting manner. Well illustrated with diagrams and photographs of the various types of arc radio apparatus used on shipboard and in shore stations. Price $2.50 per copy, postpaid in the U. S. For sale by Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

"License Quiz Book," for passing the U. S. Government radio examinations. The most popular selling radio book. Contains 106 pages of radio information. 80 illustrations. 250 questions and answers. Deals with every new radio development. Price $1.00 per copy, postpaid anywhere in the U. S., or given free with a one year subscription to "RADIO." Pacific Radio Pub. Co., Pacific Bldg., San Francisco.

Tell them that you saw it in RADIO

COPPERWELD ANTENNA WIRE

At radio frequency, the core of a wire performs no electrical service because it carries no current. The core may, therefore, be made to perform a great mechanical duty. Hence an ideal wire for radio should have a core of high strength metal (steel) and an outer covering of high conductivity metal (copper).

Copperweld antenna wire is made by permanently welding the protective and conducting outer coating of pure copper to the steel core. It has the same non-rusting qualities as copper wire. At radio frequency it has practically the same conductivity as copper wire of equal diameter.

Copperweld antenna wire is 50 per cent stronger than copper wire of equal size and will stay up under severe sleet and wind loads when other wires would be wrecked. Copperweld antenna wire does not sag and stretch with subsequent breaking as does hard-drawn copper. Many Copperweld amateur antennas have remained up during storms when hard-drawn copper antennas have broken down.

COMPLETE LIST OF BROADCASTING STATIONS

Ninety-eight radio stations were broadcasting music, concerts, lectures and market and weather reports, according to the Department of Commerce, on March 23. The list of stations sending entertainment on 360 meter wave follows:

KZM—Allen, Preston D., Hotel Oakland, Oakland, Calif.
WGI—American Radio & Research Corpn., Medford, Hillside, Mass.
KZY—Atlantic-Pacific Radio Supplies Co., Oakland, Calif.
WOR—Bamberger, L. & Co., Newark, N. J.
KJS—Bible Institute of Los Angeles.
WDM—Church of Covenant, Washington, D. C.
WBU—City of Chicago, Ill.
WHK—Cox, Warren R., Cleveland, Ohio.
WLW—Crossley Mfg. Co., Cincinnatti, Ohio.
WJX—DeForest Radio Telephone & Telegraph Co., New York, N. Y.
WWJ—Detroit News, Detroit, Mich.*
KQV—Doubleday-Hill Electric Co., Pittsburgh, Pa.
WRK—Doron Bros. Electric Co., Hamilton, Ohio.
WHU—Duck Co., Wm. B., Toledo, Ohio.
KLB—Dunn & Co., J. J., Pasadena, Calif.
KGC—Electric Lighting and Supply Co., Hollywood, Calif.
KUO—Examiner Printing Co., San Francisco, Calif.
WGY—General Electric Co., Schenectady, N. Y.
WCJ—Gilbert Co., A. C., New Haven, Conn.
KJQ—Gould, C. O., Stockton, Calif.
WLK—Hamilton Mfg. Co., Indianapolis, Ind.
WOH—Hatfield Electric Co., Indianapolis, Ind.
KQW—Herrold, Chas. D., San Jose, Calif.
KVQ—Hobrecht, J. C. (Sacramento Bee), Sacramento, Calif.
WGL—Howlett, Thos. F. J., Philadelphia, Pa.
WOC—Karlowa Radio Co., Rock Island, Ill.*
KLP—Kennedy, Colin B. Co., Los Altos, Calif.
KQL—Kluge, Arno A., Los Angeles, Calif.
KJR—Kraft, Vincent I., Seattle, Wash.
KGB—Lorden, Edwin L., San Francisco, Calif.
WSZ—Marshall-Gerken Co., Toledo, Ohio.*
WOU—Metropolitan Utilities District, Omaha, Neb.*
KDN—Meyberg Co., Leo J., San Francisco, Calif.
KYJ—Meyberg Co., Leo J., Los Angeles, Calif.
WOS—Missouri State Marketing Bureau, Jefferson City, Mo. (Markets.)
WGH—Montgomery Light & Water Power Co., Montgomery, Ala.*
WPB—Newspaper Printing Co., Pittsburgh, Pa.
KFC—Northern Radio & Electric Co., Seattle, Wash.
WOZ—Palladium Printing Co., Richmond, Ind.*
WOK—Pine Bluff Co., The, Pine Bluff, Ark.
KGF—Pomona Fixture & Wiring Co., Pomona, Calif.
KWG—Portable Wireless Tel. Co., Stockton, Calif.
WMH—Precision Equipment Co., Cincinnati, Ohio.*

Continued on page 79

Radio frequency amplification is accomplished by increasing or relaying intercepted radio signals before the energy passes through the detector tube. In audio frequency amplification the current is built up after leaving the tube detector. Weak and distinct signals can be detected by the former method, whereas they would be inaudible with the latter.

A condenser instead of an antenna for transmission and reception of radio signals is being investigated by the U. S. Bureau of Standards. Taking advantage of the fact that the ordinary aerial corresponds to one plate of a condenser and the ground to the other, a pair of large metal plates is substituted and found to be freer from static disturbances and to offer better opportunity for portable sets.

1BZX—Experimenters' Information Service station at Thomas G. Plant factory, Boston 20, Mass. Initial concert given Feb. 17, 1922.

QUERIES AND REPLIES

Continued from page 26

as several good articles on how to wind honeycomb coils have recently been published. To tap a honeycomb coil in five or six steps, estimate the number of layers in the coil and the number of turns in each layer and divide by five or six, whichever the case may be, to determine what layers are to be selected. Then scrape the insulation from the outside wire in the layers selected, and solder connecting wires at these points. The auxiliary tickler mentioned in Mr. Weihe's article is wound on the same cardboard tube with the primary, and adjacent to it.

Question: (a) Is a flat top antenna with a counterpoise strung beneath it more efficient than a vertical antenna with a counterpoise consisting of wires strung on a framework beneath the antenna?

(b) Is it more desirable to have an antenna whose natural wave is as near the 200 meter as possible or should the wave be ten or twenty meters lower and add inductance in the transmitter?

C. L. R., Lemar Grove, Calif.

Answer: (a) For 200 meter work a high vertical fan having a fundamental wave somewhat below 200 meters, used with the counterpoise you describe, would be more efficient, although not enough more than the flat top to warrant the additional expense.

(b) The wave should be nearer 40 or 50 meters lower than 200 in order to avoid the use of a series condenser.

4CB—CANADIAN

Continued from page 27

fan 80 ft., 65 ft. high and 4 wire counterpoise wi tuned gnd. Wavelength 215 M; radiation 2.2 amps C. W., and 1½ amps fone. "Surefire" crt. My receiver, long wave H. C. coils; short wave reg., variometer type; spider webs; audion det., 1 step R. F. and 2 step A. F. amplifier. Rec. aerial; break-in, 125 ft. long, one wire 95 ft. high end. Baldwin fones; loud speaker and 150 V storage "B" battery. All home-made. We use fone when calling U. S. stations and V when calling Canadian stations. U. S. stations should use "AA" when calling Canadian stations as shown in QST.

COMPLETE LIST OF BROADCASTING STATIONS

Continued from page 75

KFU—Precision Shop, Gridley, Calif.
WDW—Radio Const. & Electric Co., Washington, D. C.
WDY—Radio Corporation of America, Rosselle Park, N. J.
KJJ—Radio Shop, Sunnyvale, Calif.
KYY—Radio Telephone Shop, San Francisco, Calif.
KIZ—Reynolds Radio Co., Denver, Colo.*
WFO—Rike-Kumler Co., Dayton, Ohio.*
WHQ—Rochester Times-Union, Rochester, N. Y.*
WHW—Seeley, Stuart W., East Lansing, Mich. (Market and weather.)
WJK—Service Radio Equipment Co., Toledo, Ohio.
WDT—Ship Owners Radio Service, New York, N. Y.
WRL—Union College, Schenectady, N. Y.
WLB—University of Minnesota, Minneapolis, Minn.*
WHA—University of Wisconsin, Madison, Wis.*
KLS—Warner Bros., Oakland, Calif.
KHQ—Wasmer, Louis, Seattle, Wash.
WBZ—Westinghouse Electric & Mfg. Co., Springfield, Mass.
KYW—Westinghouse Electric & Mfg. Co., Chicago, Ill.
WJZ—Westinghouse Electric & Mfg. Co., Newark, N. J.
KDKA—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
KOG—Western Radio Electric Co., Los Angeles, Calif.
WOQ—Western Radio Co., Kansas City, Mo.*
WJH—White and Boyer, Washington, D. C.
WNO—Wireless Telephone Co., Hudson County, Jersey City, N. J.

*Designates also sending markets and weather on 485 wavelength.

WCN—Clark University, Worcester, Mass.**
WJT—Electric Equipment Co., Erie, Pa.
WSX—Erie Radio Co., Erie, Pa.
WPR—Federal Institute of Radio Teleg., Camden, N. J.
WIP—Gimbel Bros., Philadelphia, Pa.
WGV—Interstate Electric Co., New Orleans, La.
KGW—Oregonian Publishing Co., Portland, Ore.
KOA—Y. M. C. A., Denver, Colo.*
WPA—Fort Worth Record, Fort Worth, Texas.
KHJ—Kierulff, C. R. & Co., Los Angeles, Calif.
WHN—Ridgewood Times Print. and Pub. Co., Ridgewood, N. Y.
WBT—Southern Radio Co., Charlotte N. C.
WFI—Strawbridge and Clothier, Philadelphia, Pa.
WOO—Wanamaker, John, Philadelphia, Pa.
WSL—J. & M. Electric Co., Utica, N .Y.
KDPT—Southern Electric Co., San Diego, Calif.
WHD—West Va. Univ., Morgantown, W. Va.
WKY—Oklahoma Radio Shop, Oklahoma City, Okla.**
KGG—Hallock and Watson, Portland, Ore.
KGO—Altadena Radio Lab., Altadena, Calif.
WIL—Continental Electric Sup. Co., Washington, D. C.
KGU—Marion A. Mulrony, Honolulu, T. H.
WGR——Federal Tel. & Tel. Co., Buffalo, N. Y.***
KSD—Pulitzer Print. Co., St. Louis, Mo. (St. Louis Post Dispatch.)
WRW—Tarrytown Radio Research Lab., Tarrytown, N. Y.
WPM—Thos. J. Williams, Inc., Washington, D. C.
WIK—K. & L. Electric Co., McKeesport, Pa.
WRR—City of Dallas, Dallas, Texas.
KSL—The Emporium, San Francisco, Calif.
KRE—Maxwell Electric Co., Berkeley, Calif.
WBS—D. W. May, Inc., Newark, N. J.

*Only weather.
**Also weather.
***Also market and weather.

Bulletins C-1 and C-2 from Klitzen Radio Mfg. Co. of Racine, Wis., illustrate and describe the Klitzen variometer and variocoupler respectively.

5GI is heard now and then.

5XA pushes thru in fine shape.

5ZAB is one of the most active stations in the South.

5ZL helps to keep Little Rock on the map.

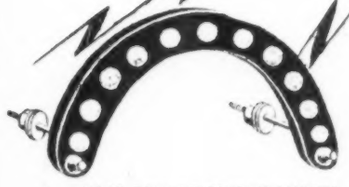
8DY breaks thru fine with his spark.

8XE now uses spark and C. W.

8LF pounds thru in fine shape.

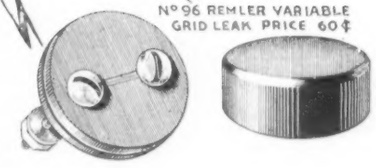
8SR is operator LM at 1BIR. 8SR will be on again as soon as he returns from school at Exeter, N. H.

REMLER ACCESSORIES FOR CUNNINGHAM RECEIVING TUBES

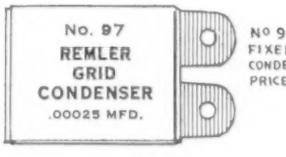


No 93 REMLER POTENTIOMETER
UNIT ONLY PRICE 75¢

CUNNINGHAM C-300 GAS CONTENT
DETECTOR PRICE $5.00



No 96 REMLER VARIABLE
GRID LEAK PRICE 60¢



No 97
FIXED GRID
CONDENSER
PRICE 35¢

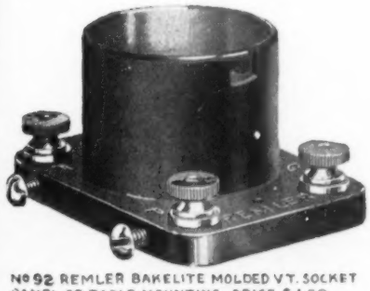
No 95 PLAIN TYPE ROTARY LEVER
SWITCH 1" RADIUS PRICE 60¢

Remler Apparatus

THE remarkably high quality of every Remler item is not accidental, but the final result of years of research work, painstaking study and perfection of manufacturing processes. The uniformly handsome appearance of the Remler line—the accuracy and precision of each individual item—the truly wonderful results that are obtained from the use of this "Apparatus That Radiates Quality"—these facts have made REMLER the choice of those who really know radio apparatus.

E. T. Cunningham

No 810 REMLER JR. PANEL
RHEOSTAT 4 OHMS RESISTANCE $1.00



No 92 REMLER BAKELITE MOLDED V.T. SOCKET
PANEL OR TABLE MOUNTING PRICE $1.50

REMLER TYPE 330 DETECTOR PANEL WITH A-BATTERY
POTENTIOMETER PLATE VOLTAGE CONTROL $8.00

REMLER RADIO MANUFACTURING COMPANY

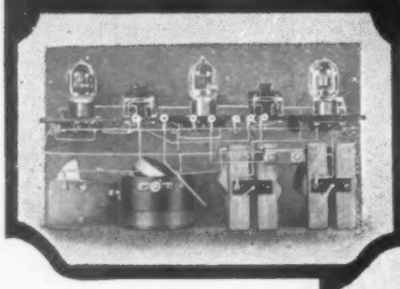
248 FIRST ST.
San Francisco, Cal.

E. T. CUNNINGHAM
General Manager

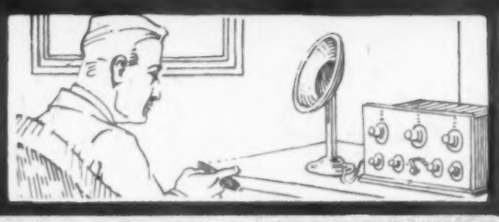
154 W. LAKE ST.
Chicago, Ill.

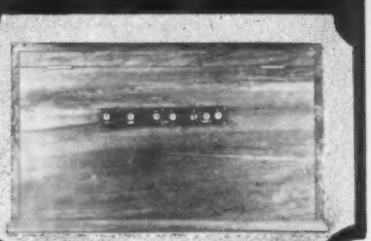
Apparatus that Radiates Quality

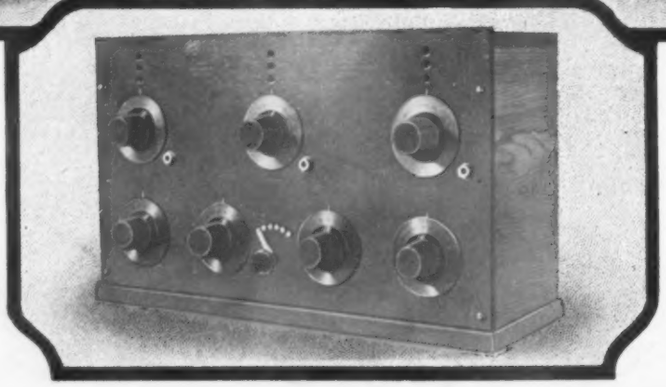
The MAN'S Set—



A view showing interior arrangement. Note the compactness and utter simplicity. The variometers are of special mahogany, designed for maximum inductance ratio from minimum to maximum. The detector circuit includes copper foil and mica grid and plate condensers with tubular grid leak. General radio sockets.







Exterior view of rear of set. Note the hinges, the entire top may be swung back, thus giving easy access to everything inside. Note the insulated panel in the rear center, to which all connections are made, thus freeing the front of unsightly wires. Note also the sturdy thickness of the heavy gumwood cabinet frame.

New regenerative receiver set TYPE A-P ONE

Manufactured by The Radio Shop, Sunnyvale, Cal. ***Exclusive distributors—Atlantic-Pacific Radio Supplies Co.***

If you would get a man's enjoyment from radio, you don't want a toy, you want a ***man's*** set. The new Regenerative Receiver Set, Type A-P one, is designed as a ***man's*** set. A real practical serviceable and efficient outfit for a man's office, his amateur station, or his home.

The cabinet is of grained gumwood, with a beautiful piano finish. The panel is of heavy Formica, on which all lettering is machine engraved in white. The dials are of polished German silver, with black engraved divisions in figures, and fitted with large tapering knobs, enabling fine tuning. The 180° rheostat matches the other dials. All wires and all metal parts, both exterior and interior, are nickel plated.

The set is designed especially for short-wave lengths of from 150 to 450 meters, to insure maximum audibility and clearness for concert and amateur use. Particularly is it ideal for home entertainment in receiving radio music, radio news, and other broadcasted features. But with real man-like versatility it operates with equal efficiency in receiving spark and C W. A-P vacuum tubes used throughout.

Whether you ***know*** radio, or simply know you are interested, Type A-P One is the set you want. Simple in adjustment, and extremely selective, yet highly sensitive. When you buy a set, make sure it's—***"A MAN'S set."***

Call for a demonstration, or write us for a folder giving prices and full particulars. Orders should be placed quickly to insure delivery at the earliest possible moment.

DEALERS and JOBBERS—we have a man's proposition for you on ***"the Man's set."*** *Write us.*

ATLANTIC-PACIFIC RADIO SUPPLIES COMPANY

Henry M. Shaw, President

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SAN FRANCISCO, CALIFORNIA

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